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## CIVIL ENGINEERING.

*On the Asphalted Macadamised Roads lately laid down in Paris. Compiled from 'Les Annales des Ponts et Chaussées, 1850.' By* M. De Coulaine, *Engineer of the 'Ponts et Chaussées.'**

### Chapter I.

The first applications of bituminous substances to roadways were made in Paris, on la Place Louis XV.,—opposite to the Church of St. Roch, and at the extremities of several streets on the Boulevards. In these essays, blocks 6 inches thick, formed of fragments of quartz, in a bituminous mastic, with a base of coal tar, were placed on a bed of sand; spaces from $1\frac{1}{4}$ to $1\frac{1}{2}$ inches wide, were left between them, which were subsequently filled in with the mastic.

The results obtained were far from being such as had been anticipated. The bitumen made with the coal tar (which is friable, especially at a low temperature,) was very soon pulverized; the stones became detached; and the paving, at first exceedingly even, shortly became as rough as the very worst paving upon the old systems.

Other trials were made, in which a kind of concrete, with a base of coal tar bitumen, was employed: the success was not greater than before.

The principal defect of these systems consisted in the use of the coal tar. A bituminous mastic, in order to be able to resist the continuous action of carriage traffic, should preserve, even during the hardest frosts, a malleability which will allow it to alter its form without breaking, instead of being hard and brittle. In the first essays, hardness was the only quality sought for, whilst ductility, or suppleness, should have been the object. Starting, therefore, upon principles diametrically opposite, it is

* From the London Civil Engineer and Architect's Journal, for March 1851.

not to be wondered at that such different results should have been obtained as those about to be mentioned.

Before describing the experiments made on the subject, it is indispensable to enter into some preliminary details upon the nature, properties, and composition of bituminous matters.

## Chapter II.—Composition and Properties of Bituminous Matters.

*Composition of Bituminous Mastics.*—These mastics are principally composed of bitumen, or mineral tar, and of limestone. In the greater number of cases in which it is applied, a sharp sand is added to these two substances. But the choice of the bitumen and the limestone are the only really important parts of the operation: their qualities should be as follows:

*Composition, Qualities, and Properties of the Bitumen.*—The bitumens, or mineral tars, belong to the class of mineral combustibles. At the ordinary temperature of the atmosphere, they are sometimes dry and brittle; at others, soft, viscous, or even liquid. In the intermediate state, they spread and flow slowly; they may be observed to yield progressively to the weight of any superincumbent body; whilst a weight even much heavier, if thrown suddenly on their surface, bounds off again without leaving even a sensible trace. They contract very sensibly under great colds. They melt at a point a little above 212° Fah. Between 250° and 290°, they give off dense smoke, and begin to boil. The product of the distillation is an oil, the properties of which vary according to the nature of the tar. In proportion as the distillation advances, the liquidity and elasticity of the bitumen diminishes. When, at length, all the vapors have passed off, nothing is left but a black substance, brittle at ordinary temperatures, shiny, and which, by the application of a prolonged heat, decomposes with the greatest facility. Operating synthetically, and placing in contact the two elements which have been thus separated by heat, they recombine, and reproduce a bitumen similar to the one operated upon.

The mineral tars, then, are composed in a similar manner to fatty substances, and contain two principles analagous to the *stearine* and *olein* of the latter. And it is from this composition, hitherto apparently unnoticed, that all the properties of the bitumens are derived, as are also those of the mastics, into the composition of which they enter. Hitherto, no explanation has been offered of the differences to be observed in them: it would appear to result from the nature of the oils they contain.

Thus, the oil which coal tar contains possesses a very disagreeable odor, similar to that of the tar itself. Perfectly limpid and colorless when freshly distilled, it discolors and carbonises upon contact with the atmosphere. It is excessively volatile, even at the ordinary temperature. Thence it is that the coal tar dries with great rapidity, and produces very brittle mastics. It is useless to endeavor to obtain a sufficient consistence by regulating the intensity of the fire; this consistence becomes promptly altered by the spontaneous evaporation of the oil above mentioned.

The Bastenne bitumen, on the contrary, contains an oil much less volatile—one which is more persistent in its character, and which does

not evaporate sensibly in the open air. By conforming, therefore, to the prescriptions indicated in the following part of this notice, very excellent bituminous mastics are prepared from it.

It is possible to communicate to the coal tar a portion of the qualities of the Bastenne bitumen, by concentrating it sufficiently, and replacing the oil which has evaporated by a more fixed oil. Some footpaths executed with bitumen thus prepared, have succeeded tolerably well. But it has been found very difficult to effect perfectly the substitution alluded to. It has, in fact, been noticed that when the distillation approached its termination, the bitumen decomposed. It becomes, then, necessary not to carry this operation to the extreme, and the consequence is, that the mastic, obtained in this manner, contains some volatile oil. If the substitution were complete, the price would be found to be at least equal to that of the Bastenne bitumen, such as is met with in commerce.

*Composition and Qualities of the Limestones.*—The limestones which enter into the composition of the bituminous mastics are of two sorts—1. The limestones, properly so called. 2. The natural asphaltes, or the bituminous limestones.

The limestones, properly so called, should be pure, or at least contain as small a portion as possible of foreign substances. Inasmuch as sulphur renders the mastics brittle, such stones as contain it should be rejected. In order that the limestone may easily combine with the bitumen, it is indispensable that it should be reduced to an impalpable powder. Unslaked lime has been employed, in a ground state, with perfect success.

The bituminous limestones hitherto employed have been the asphaltes of Seyssel, Val-de-Travers, and of Lobsann; they are principally composed of a carbonate of lime and a bitumen completely identical with that of Bastenne. These two elements are generally combined in the proportions of nine parts of the carbonate of lime to one of bitumen.

Before submitting the asphalte to fusion in combination with the bitumen, it is indispensable to reduce it to a fine powder, either by some mechanical means, or by action of the heat, which causes it to decrepitate and fall to dust. In this state it enters rapidly into combination with the bitumen.

The pure limestones, however, required a prolonged heat before they enter into combination, and this is susceptible of altering the qualities of the mastic. Moreover, it is to be feared that the combination of the bitumen and of the limestone should not be so intimate as that of the former with the asphalte, and that the mastic should not present the degree of homogeneity required. As the use of limestones does not offer any appreciable economy, it appears that no hesitation should be felt in giving the preference to the natural asphaltes.

Resuming, then, what has been above stated, the two substances which ought to form the base of the composition of bituminous mastics are—first, the Bastenne Bitumen; secondly, the Calcareous Asphaltes.

*Qualities of the Sand.*—As to the sharp sands added in most cases, the only important condition they are required to fulfil is, that they be exempt from any earthy matters.

## Chapter III.—Preparation and Mode of Use of the Bituminous Mastics intended for the Making of Roads, or of Footpaths.

Having thus exposed the principles which affect the chemical application of the materials, it is proposed to explain the methods followed in preparing the mastics for roadways.

*Proportions of the Materials used.*—The substances described previously, when employed with the necessary precautions, answer perfectly, so long as it is only required to form ordinary footpaths. For carriage-ways it is, however, necessary to introduce some modifications; for instance, an essential oil is required to be added in order to give the mastic all the malleability and the suppleness required.

The oil employed by M. de Coulaine is the oil of resin. Any other fat oil, not exposed to the inconvenience of drying, may be substituted for this; but their odor is generally disagreeable, and their price usually more elevated.

The materials thus mentioned should be employed in the following proportions, in weight avoirdupois:—

| | |
|---|---|
| Bastenne Bitumen, . . . . | 16·875 lb. |
| Asphalte of Seyssel, . . . . | 225·000 |
| Oil of Resin, . . . . . | 6·250 |
| Sand, . . . . . | 135·000 |

*Melting.*—The above materials are successively introduced into the cauldrons in which the melting is to be effected. The bitumen is melted first, the asphalte is then to be added in small portions. When the pulverisation of the latter is effected by heat, it is preferable to carry on the two operations simultaneously, and to pour the asphalte into the cauldron whilst it is still warm. A portion of the bitumen is thus saved, the expense of fuel is much diminished, and the preparation of the mastic is carried on more rapidly. Lastly, when the asphalte is completely dissolved in the bitumen, the oil and the sand are to be added. During the whole of this operation it is indispensable to stir the materials continually, in order that the combination may be perfect, and that the mastic which touches the sides of the cauldron may not be burnt.

The termination of the operation is announced by the rising of steam bubbles to the surface, which explode there and give off a bluish flame. It then becomes important to verify if the mastic has a proper degree of concentration.

We have indeed seen that the bitumen loses its elasticity progressively, in proportion as it loses by evaporation a part of the oil it contains. The same thing occurs with the mastic; the consistence it is likely to take on cooling does not only depend on the proportions of the materials employed, but also on the composition of the bitumen and the asphalte, as well as upon the duration and intensity of the heat they are exposed to.

Now the actual state of the material in this stage of the process affords but little indication of this consistence; for, at a high degree of temperature, the two elements of which the mastics are formed give them the same liquidity. Thus, a cauldron of material, thick and difficult to stir, because it does not contain a sufficient quantity of bituminous matters,

would, nevertheless, yield a product which would be very soft if the proportion of oil were too great; whilst the most fluid mastic, on the other hand, may become brittle when the other element is in excess. It is, indeed, easily conceivable that both these cases should frequently occur in practice. Suppose, for instance, that the bitumen employed is very soft, that is to say, that it contains a large quantity of oil, it will be necessary to evaporate the greater part of this oil, and the matter, perhaps, will become too thick to be employed before it can obtain, by cooling, a sufficient degree of firmness. The opposite effect would occur if the bitumen were too much concentrated.

The duration of the melting cannot either be taken as a rule; for the intensity of the fire, the exterior temperature, the strength of the wind, all exercise a great influence on its results.

Nevertheless, it is indispensable to ascertain whether the asphaltic mastic fulfils the requisite conditions, and that after it has been employed it will not present either an excess of hardness, which should lead to its being crushed, nor an excess of softness, which should lead to deformations and increase the draught. The workman who applies the mastic can judge whether it is of a proper degree of fluidity at the moment when he pours it out; but, as we have said, he cannot, from that indication, predicate the degree of consistence it will attain when it cools. The following method of ascertaining the latter condition has been adopted.

*Preliminary Trial of the Mastic.*—The workman entrusted with the superintendence of the cauldrons, pours a small sample of the mastic, about three inches long by two inches wide, and half an inch thick, upon a wrought iron plate, whose ends are turned up all round. He then moves this sample about in water maintained at 77° Fah., until it has attained the same temperature, and it is then tried in the following manner:—

He takes a small board, upon which are fixed two steel points, having the form of quadrangular pyramids, whose height equals the side of the base. He places one of the points on the sample to be tried, and the other on a similar sample previously prepared, of the degree of consistency required and maintained at the same degree of temperature. He stands upon the board, and with his whole weight gives it a slight movement to and fro, so as to cause the points to enter into the two samples. To indicate that the melting has been carried to the proper degree it is evidently necessary that the two points should enter in a similar manner. This, of course, can be ascertained precisely, by measuring the side of the impressions, whose depths will, of course, be precisely the same, owing to the form of the points described above.

From many experiments made upon this subject, it appears that, the weight of the workman being usually from 140 lbs. to 160 lbs., avoirdupois, the side of the impression should be about three inches when the mastic is to be used for roads. For covering arches, terraces, &c., it should be about two and a half inches; for foot paving, or similar external works, it should be about two inches. In the latter case the addition of the oil of resin ceases to be necessary, unless the melting should have been too much prolonged.

When the width of the impression is less than two inches, the mastic, which shrinks in cold weather more than the substances it is combined with, does not possess sufficient elasticity to allow that movement to be carried on freely. It tears asunder, and principally in the direction of the soldered joints.

The above indications only refer to the climate of France. It is evident that they must be modified for countries in which the climate might be different.

If the width of the impression be less than the dimensions given above, oil is to be added, and well mixed with the contents of the cauldron, and experiments are made successively until the proper degree of consistence is attained. If the oil should have rendered the mastic too liquid, a certain quantity of asphalte or of sand should be added. When, on the contrary, the width exceeds those dimensions, the boiling should be continued until the mastic becomes sufficiently concentrated. If, during this operation, it should happen to become too thick, a quantity of bitumen should be added, sufficient to bring it to a condition such as would allow of its being easily spread. Care must, however, be taken not to render it too liquid, because an excess of that quality would give rise to the double inconvenience of rendering the work executed with it too soft in summer, and too hard and brittle in winter. Indeed, to prevent the bituminous mastics from exercising different actions in different conditions of temperature, it is necessary, not only that they should satisfy certain conditions at one particular degree, but that they should be able to do so at any other (at that which corresponds with their fusion point for instance); and it is evident that the nearer the last may approach the first, the less the mastics are likely to be affected by alternations of heat or cold, because it is a proof that they contain a greater proportion of the element which always retains its fluidity. However, when the impression has reached the precise dimensions above indicated, the fire must be removed, in order that the mastic may not become more concentrated, and the application is to be at once commenced.

Too much attention cannot be paid to this mode of proof, which M. de Coulaine regards as being even more important than the choice of the materials.

*Mode of Employing the Mastic.*—This operation, as far as ordinary footpaths are concerned, is executed in widths of such a size as to allow a man to reach from side to side without touching either edge; that is to say, about two feet six inches.

The material is laid between two wooden gauges, for the first width; their height being regulated by the depth proposed to be given to the mastic. The material is spread by a species of iron trowel, and levelled by means of a rule, resting upon the two gauges in the first width, and on the external gauge and the finished paving for the remainder.

As the levelling of the mastic proceeds, another workman sprinkles sand over the surface by means of a sieve. When he has thus covered about two feet six inches in lengh, he should bring the superabundant sand, by means of a very supple brush, upon the part which has hitherto received none, and with a double-handled rammer he should strike flatly upon the whole surface, so as to force the gravel to enter into the

mastic and combine with it. This operation is intended to force the bitumen upon the surface prepared for its reception. It should be done quickly, and by the same man, who also, as soon as it is finished, should strike a series of light blows with an iron hammer upon the still warm material, on the line of its junction with the matter last placed, so as to solder the two edges together in a perfectly solid manner.

In the first trials which were made, under the direction of M. de Coulaine, he introduced small pebbles into the bituminous layer at the moment of its application: but subsequently he abandoned the practice. For he found that whatever the hardness of the stones might be, all of them became crushed under the direct action of the traffic, and that the bitumen was partly brought over them. This action occurred inevitably, because the stones received the whole weight, and they were too small to be able to resist its action. So far, then, from adding to the solidity of the roadway, they only served to diminish it, by forming, on its surface, series of little holes which facilitated its rupture; which were a cause of infiltrations; and upon the edges of which the mastic became detached into thin layers, and finally came off in flakes.

## Chapter IV.—Preparation of the Foundation destined to Receive the Bituminous Mastics.

An ordinary broken stone road, solidified and proved by the ordinary traffic, is at the same time the easiest and the most economical in its construction of any such foundation. The concrete employed hitherto, in the general applications, cannot be considered as offering sufficient guarantees. Indeed, concrete must require a sufficient interval of time between its execution and the time of use, to attain its ultimate strength; and even then, its solidity can hardly be comparable with that of a good macadamised road. To prove this assertion, it is only necessary to allow the road traffic to pass over even the very best description of concrete, and it will be found to fall to pieces almost immediately. M. de Coulaine states that he tried a piece of road thus executed in concrete, in which none but the best hydraulic lime was used, and, although it had been executed more than a year before it was delivered to public traffic, it became quickly upset, and it was found necessary to cover it with a thick coat of ordinary stone. In spite of this repair, the roadway appeared always to suffer from the original defect of its formation. Nor can this result be a matter of surprise, if we reflect on the mode of aggregation of the materials in the two respective cases.

Indeed, in a roadway, the aggregation of the materials is effected by compression in such a manner, that when the roadway has become perfectly hard, the stones are, as it were, wedged together, and only hold the quantity of detritus necessary to fill exactly the interstices. It is easily conceivable that the traffic should have little effect on a similar road; and even that, under some circumstances, it should only serve to add to its solidity.

With concrete, on the other hand, the stones do not generally touch one another: they are bound together by mortar, which having but a trifling hardness, and being also devoid of elasticity, is promptly destroyed by the action of the rolling carriages. If even the stones should

be as closely agglomerated as in a roadway, the mortar which binds them together and fills their interstices, contains too many calcareous substances to form the kind of detritus able to produce a resisting roadway.

Concrete has another radical defect—namely, that of swelling with frost, should it not be completely dry, or should it be cut up by the traffic. It follows from this, that the bituminous layer which is thus raised by the concrete, is easily broken when a thaw sets in. The unslaked particles of lime produce, by the commencement of that action after the concrete is in its definite position, bubbles, or elevations, of considerable size in the paving which covers them. These disadvantages are of serious moment, even when a common paving is only concerned: in a roadway they would be vital. M. Coulaine observes, that he is far from asserting that a perfectly executed bed of concrete may not succeed; but if a good macadamised road be preferable, why employ a more doubtful and more expensive process?

The reasons above given, led M. de Coulaine to abandon the use of concrete, even for foot-pavings, and to replace it by a layer of broken stones two inches thick, compressed and sanded. This has been invariably found to be successful; and in such cases, the swelling up so often observed against the curb in ordinary bituminous paving, does not occur. Independently of this advantage, there is a notable economy; and the bituminous mastic can be applied in winter as in summer, immediately after the broken stone has been laid down.

When it is required to cover a road for the purpose of carriage traffic, the course to be pursued is as follows:—

A macadamised roadway of broken stone is to be formed of such materials as are not likely to furnish a detritus of a nature to expand by the action of frost; this must be consolidated to an extent sufficient to support any kind of traffic; in fact, a perfect macadamised road must be formed, in any of the usual manners employed, either by the use of the cylinder, or by allowing the road materials to be consolidated by the traffic. If a good roadway already exist, composed of materials little subject to the action of frost, it may be used. As an additional precaution, and to regularise its surface, it is, however, advisable to cover it with a layer of materials about two inches thick, which must be well compressed.

## Chapter V.—Dimensions to be given to Bituminous Roadways.—Seasons in which they should be Executed.

*Thickness of the Roadways.*—The system of foundation, above recommended, allows the thickness of the bituminous coating to be considerably diminished. In some cases it has not exceeded $\frac{3}{4}$ of an inch —that is to say, not more than is usually employed for a foot-path—without any inconvenience being experienced. A thickness of $1\frac{1}{4}$ to $1\frac{3}{8}$ of an inch, gradually increasing from the sides towards the middle, appears then to be perfectly satisfactory, and all that is required for the purpose. The adoption of a greater thickness would but augment the expense without adding to the solidity; it would augment also the diffi-

culties of laying or repairing gas pipes, &c.; and, moreover, would present a greater mass of material liable to be acted upon by the heat of summer.

For the same reason, the rounding of the transverse section should be as small as possible; and it should never exceed more than $\frac{1}{100}$th of the width of the road.

*Seasons in which the Bituminous Roadways should be Executed.*—Lastly, in addition to the above conditions, there is another very important one to be observed. In order to obtain satisfactory results, it is almost indispensable that the materials be applied in fine weather; when in cold weather, a surface, which can never be entirely exempt from moisture, is operated upon, little interstices are found between the foundation and the mastic, owing to the presence of the aqueous vapors. Now, the bitumen does not retain, at a low temperature, a sufficient degree of elasticity to allow of its filling these little interstices, and bearing exactly upon the subjacent surface, without some rapture being produced by the traffic. It is also to be feared that some parts of the macadamised substratum may not have become solidified, and that accidents may arise from this cause. During the warm weather, however, the bituminous coating adapts itself, without breaking, to the foundation under the pressure of the wheels of the passing traffic; it follows, also, without breaking any subsidence which the foundation may be exposed to. The latter has thus time to become consolidated in those parts where such an operation may be necessary; and when winter arrives, it has thus attained a sufficient degree of hardness to remove any fear of similar accidents.

It would be advisable to limit the time for using the bituminous mastics to the period between May and September. A previously executed roadway of this material may be excepted, for that may be repaired at any time.

Such are the conditions which M. de Coulaine, who has already had considerable experience in the use of this material, considers to be indispensable to insure the success of the application of the bituminous mastics. By observing them scrupulously, there appears to be little doubt of obtaining successful results.

### Chapter VI.—Account of works executed.—Roadway and Impermeable Covering to the Arches of the Bridge over the Loire at Saumur.—Precautions to be taken in executing such Coverings.

The first essay of a roadway in bitumen executed by M. de Coulaine was executed upon a macadamised road joining the paving of the national road from Bordeaux to Rouen. The surface of this road was picked over, then covered with a layer of stones 2 inches thick, and compressed by a roller of 10 tons weight. This operation was performed in order to obtain a surface perfectly hard and even.

In different portions the thickness of the bituminous coating was varied, as were also the proportions of the asphalte and of the sand. Small pebbles were, moreover, placed by hand in the asphalte, at the moment of its being employed.

This essay was made upon a length of 66 feet, and a width of 13 feet.

The average number of collars traversing it (or of draught horses pulling from a collar) was 150; the number being taken between six in the morning and six at night. It was opened to traffic on October 6, 1840.

In March 1849, the only remarkable decay had taken place in the portions executed with a thickness of about $\frac{3}{4}$ inch to 1 inch, or in those which contained an excess of sand. All the other portions have resisted well during the nine years they have been exposed to wear. Nevertheless, the stones which projected, and were very close together, became all crushed, but the space they left was filled gradually by the bitumen adjoining, and it alone now appears upon the surface. It is principally to this defective execution, namely, the introdction of the small stones, that the few inequalities to be observed are owing. It is also necessary to add that the mastic had not been submitted to the trial above indicated.

Guided by the information obtained from the experience of these first essays, other applications were made elsewhere on a larger scale, avoiding successively the defects which were found to exist; and the last applications, especially, have produced the most satisfactory results.

The covering of the arches of the great bridge over the Loire, at Saumur, may be mentioned first. It is about 920 feet long by 25 ft. 3 in. wide. The thickness of the bituminous coating was made $1\frac{5}{8}$ inches. The macadamised foundation was laid upon the bed of the old paving, and it has a thickness of 4 inches. The first parts of this roadway were under constant use from September 1841, to March 1849, and retained their form perfectly.

During warm weather the wheels form slight ruts, but these marks are soon mutually effaced by the action of the traffic; and they disappear altogether when the temperature becomes lowered. If a carriage, instead of being in movement, remain long upon the road in the same place, it leaves a more perceptible mark, attaining sometimes a very considerable depth. This is the deeper in proportion as the time of stationing is prolonged, and also to the heat of the weather; but it also disappears, however deep, under the effect of the traffic. In ordinary weather, and under ordinary circumstances, the heaviest loads hardly leave a perceptible trace; and yet the roadway preserves, during the most severe frost, an elasticity which prevents its breaking or falling to pieces in any manner; the feet of horses alone appear to detach some fragments. All the effect produced by traffic seems, then, to be merely to alter the form. The result is, that notwithstanding the small amount of hardness of the roadway, it wears away very slowly.

Some deformations took place where the mastic had been used in too fluid a state; but only in those where the proof already mentioned had not been applied.

The twelve arches upon which this roadway was laid, have become perfectly water-tight: before its execution they were all, more or less, permeable, although they had been covered with a coating of hydraulic lime, executed with the greatest care. We know, indeed, that coatings of this nature do not preserve arches effectually from moisture, but in certain conditions—when, for instance, transverse or longitudinal inclinations afford free passage to the waters. If this condition be not fulfilled,

the slightest crevice gives rise to filtrations. But when the centres of any large arch are removed, there always occur fissures, of a greater or less degree of importance, at the springing of the arches. This action is aggravated by the alternations of heat and cold, which successively open and close these fissures, and which would also inevitably produce them if they did not previously exist.

The bridge at Saumur is precisely under these conditions. The covering is horizontal, the span of the arches is 66 feet, and during the extremes of temperature it is easy to perceive the alternate movements above-mentioned. The bituminous mastics, on account of their natural elasticity, generally resist their action. Nevertheless, it is to be feared that this would not always be the case if the roadway were immediately laid upon the masonry; and it would be prudent to interpose another body, such as a bed of sand, covered by a coating of macadam about 2 inches thick, so as to prevent the movements of contraction and dilation from affecting the mastic.

From what has been just said, it is easily to be understood that the covering of the bridge at Saumur, by a roadway in bitumen, should, at the same time, render it perfectly water-tight; and it was principally with this view that the work was executed. By its inclinations, and open gutters,—by its entire independence of the masonry, as much as by its natural impermeability, it assures the perfect dryness of the arches: and as the fissures which may exist upon its surface, by their becoming visible during wet weather, can be easily visited and repaired, this kind of covering for arches has an advantage which the ordinary ones, covered by a paving themselves, can never possess; and, moreover, as the bituminous roadways obviate the shocks to which the masonry is exposed from the traffic, they present, on that account alone, a great recommendation.

*Precautions to be taken generally in Covering Arches.*—In order to ensure in all cases a perfect union of the mastic with the footways, parapets, or walls, and to hinder the filtrations which might take place at their junctions, it will be necessary to cut a groove, of about 2 inches deep horizontally, and extending an inch both above and below the asphalte vertically, so as to form a tongue. To render the union more perfect, the sides of the groove should be covered with liquid bitumen, applied hot; and it should be filled with the mastic at the same time as the paving is executed, taking care to fill in the corner with a species of inclined plane

When it is required to cover a new building, it is preferable to carry the coating over the whole surface of the construction, and consequently to carry it under the walls and parapets which are intended to surround the terrace; or to continue the mastic up the inside or over the top of the walls, according to the circumstances of the case. Any masonry, with its joints, or artificial rendering, is far from impermeable; and it is on account of having neglected the precautions above indicated, that, under many cases, humidity has entered into buildings covered by bitumen.

In such parts as are intended to support any superincumbent masonry, small blocks must be introduced to prevent the bitumen from being squeezed out.

*Other Essays.*—A part of the road from Briare to Anger was also covered in bitumen for a length of about 560 feet, by 20 feet wide. It had resisted perfectly from the commencement of 1842 to March 1849. Its thickness was $1\frac{1}{4}$ inch, but in places it was safely reduced to $\frac{3}{4}$ inch.

A portion, about 50 feet long by 40 feet wide, of the road over the bridge at Tours, on the route from Paris to Bayonne, was laid down in May 1842. It had resisted, up to 1849, a daily circulation of 800 collars, and the arch had become perfectly dry.

The crossing at the end of la Rue Laffite, on the Boulevard, may also be cited. It is situated in one of the most frequented parts of that busy part of Paris, and is traversed by not less than from 3000 to 4000 collars per day. It was executed with a thickness of not less than $2\frac{1}{4}$ inches, upon a previously existing, but then ruined, pavement in bitumen. Notwithstanding the great passage and thoroughfare upon it, this sample has stood perfectly for more than six years.

If this piece of asphalted road be compared with any specimen of stone paving, however carefully executed in the materials usually employed at Paris, the superiority of the pavement in bitumen at the end of la Rue Laffite must be evident.

(To be Continued.)

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*Specification of the Patent granted to* EDWARD DUNN,* *for an Improved Engine for Producing Motive Power by the Dilatation or Expansion of certain Fluids or Gases caused by the application of Caloric.*—Sealed 26th December, 1850; Enrolled June 26, 1851.†

The invention consists in producing motive power by the application of caloric to atmospheric air or other permanent gases or fluids susceptible of considerable expansion by the increase of temperature,—the mode of applying the caloric being such, that after having caused the expansion or dilatation which produces the motive power, the caloric is transferred to certain metallic substances, and again re-transferred from these substances to the acting medium at certain intervals, or at each successive stroke of the motive engine; the principal supply of caloric being thereby rendered independent of combustion or consumption of fuel accordingly, whilst in the steam engine, the caloric is constantly wasted by being passed into the condenser, or by being carried off into the atmosphere. In the improved engine, the caloric is employed over and over again, enabling me to dispense with the employment of combustibles, excepting for the purpose of restoring the heat lost by the expansion of the acting medium, and that lost by radiation also, for the purpose of making good the small deficiency unavoidable in the transfer of the caloric.

Having thus stated the object and general character, I will now proceed to describe the structure of the improved engine for producing motive power, reference being had to the drawing.

Figs. 1 and 2 represent longitudinal sections of the engine, both being alike in all essential points, differing only in part of the detail, as will be clearly seen by the following description:—

I will first describe fig. 1. A and B, are two cylinders of unequal

* Agent for John Erricsson, of the United States.

† From the London Repertory of Patent Inventions, for August, 1850.

diameter, accurately bored and provided with pistons, *a* and *b*, the latter having air-tight metallic packing-rings inserted at their circumferences. I call A, the supply cylinder, and B, the working cylinder. $a^1$, piston-rod attached to the piston, *a*, working through a stuffing-box in the cover of the supply cylinder. C, is a cylinder with a spherical bottom attached to the bottom of the working cylinder at *c*, *c*. I call this vessel the expansion heater. D, D, rods, or braces, connecting together the supply piston, *a*, and the working piston, *b*. E, is a self-acting valve, opening inwards to the supply cylinder. F, a similar valve, opening outwards from said cylinder, and contained within the valve-box, $f^1$. G, is a cylindrical vessel, which I call the receiver, connected to the valve-box, *f*, by means of the pipe $g^2$. H, a cylindrical vessel, with an inverted sphe-

Fig. 1.

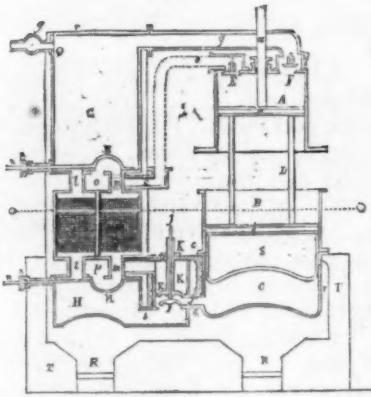


Fig. 2.

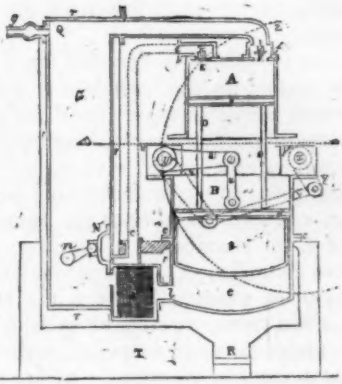


Fig. 3.

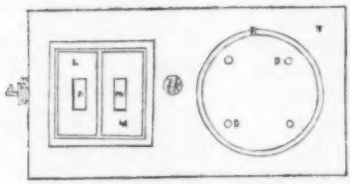
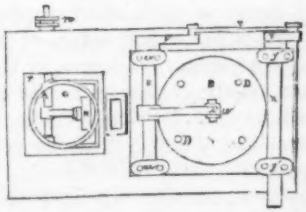


Fig. 4.



rical bottom. I call this vessel the heater. J, a conical valve, supported by the valve stem, *j*, and working in the valve chamber, $J^1$, which chamber also forms a communication between the expansion heater, C, and heater, H, by means of the passage, *h*. K, is another conical valve, supported by the hollow valve stem, *k*, and contained within the valve chamber, $k^1$. L, and M, two vessels of cubical form, filled to their utmost capacity, excepting small spaces at top and bottom, with disks of wire —net or straight wires—closely packed, or with other small metallic substances, or mineral substances, such as asbestos, so arranged as to have minute channels running up and down. I call these vessels, L, and M, with their contents, regenerators. *l*, *l*, *m*, *m*, pipes, forming a direct communication between the receiver, G, and the heater, H, through the regene-

rators. N, N, two ordinary slide valves, arranged to form alternate communications between the pipes, *l*, *l*, *m*, *m*, and the exhaust chambers, O, and P, on the principle of the valves of ordinary high pressure steam engines. *n*, *n*, valves, stems working through stuffing-boxes. $n^1$, $n^1$, *p*, pipe communicating between the valve chamber $k^1$, and exhaust chamber, P. $o^1$, pipe leading from exhaust chamber. O, Q, pipe leading into the receiver G, provided with a stop cock, *q*. R, R, fire-places for heating the vessels, H and C. *r*, *r*, *r*, *r*, flues leading from said fire-places, and terminating at $r^1$. S, a cylindrical vessel attached to the working piston, *b*, having a spherical bottom corresponding to the expansion vessel, C. This vessel, S, which I call the heat intercepting vessel, is to be filled with fire-clay at the bottom, and ashes, charcoal, and other non-conducting substances towards the top: its object being to prevent any intense or injurious heat from reaching the working piston and cylinder. T, T, brickwork, or other fire-proof material, surrounding the fire-places and heaters.

I now proceed to describe fig. 2. All corresponding parts in this figure are marked by similar letters of reference, as in fig. 1. It will, however, be well briefly to repeat the description of the same. A, supply cylinder; *a*, supply piston. B, working cylinder; *b*, working piston. C, expansion heater; *c*, junction of working cylinder and expansion heater. D, connecting the supply and working pistons. E, inlet valve of supply cylinder; *e*, valve chamber of the same. F, outlet valve of supply cylinder, and *f*, its chamber. G, receiver; *g*, pipe connecting the same to outlet valve chamber, *f*. L, regenerator; *l*, passage between the same and receiver; $l^1$, passage between the regenerator and the expansion heater. $N^1$, slide valve; *n*, stem or spindle, for working same. O, exhaust chamber under the slide valve; $o^1$, outlet pipe. Q, pipe leading into receiver; *q*, stop cock in the same. R, fire-place; *r*, *r*, *r*, *r*, flues leading from said fire-place; $r^1$, exit of said flues. T, brickwork surrounding the fire-place and flue. U, rock shaft, supported at both ends by appropriate pillar blocks; *u*, $u^1$, crank lever, or arm, attached to the said rock shaft; $u^2$, link connecting said arm to the working piston, *b*. V, another crank lever, or arm, attached to the extreme end of the rock shaft. *x*, crank shaft, or axle, having a crank, Y, firmly attached. *v*, connecting rod, connecting the arm V, to the crank pin, *y*, of crank Y; $y^1$, pillar blocks, supporting the crank shaft, *x*. Z, Z, represent the circumference of a fly-wheel, paddle-wheel, propeller, or other rotary instrument to be worked by the engine.

Fig. 3, represents a sectional plan of fig. 1; and

Fig. 4, a sectional plan of fig. 2.

Before describing the operation of the improved engine, it will be proper to observe that the piston rod, $a^1$, only receives and transmits the differential force of the piston, *b*, viz: the excess of its acting force over the re-acting force of piston, *a*. It will also be proper to observe that this differential force imparted to said piston rod may be communicated to machinery by any of the ordinary means, such as links, connecting rods, and cranks; or it may be transmitted directly for such purposes as pumping or blowing. I have further to observe that the conical valves, K and J, may be worked by any of the ordinary means, such as eccen-

trics or cams, provided the means adopted be so arranged that the valve, K, will commence to open the instant that the piston, *b*, arrives at the full up-stroke, and be again closed the instant the piston arrives at full down-stroke; whilst the valve J, is made to open at the same moment, and to close shortly before or at the termination of the up-stroke. In like manner the slide valve, N, is to open and close as the piston, *b*, arrives respectively at its up and down stroke, similar to the slide-valve of an ordinary high pressure engine. It will be seen that the link, $w''$, like the piston-rod, $a'$, only transmits the differential or useful force of the piston, *b*.

Having thus described the construction of the engine, I will now proceed to describe the manner in which the same is to be put into operation, reference being first had to fig. 1. Before starting, fuel is put into the fire-places, R, R, and ignited, a slow combustion being kept up until the heaters and lower parts of the regenerators shall have been brought to a temperature of about 500 degrees. By means of a hand pump, or other similar means, atmospheric air is then to be forced into the receiver, G, through the pipe Q, until there is an internal pressure of some eight or ten pounds to the square inch. The valve, J, is then to be opened, as shown in the drawing; the pressure entering under the piston, *b*, will cause the same to move upwards, and the air contained in A, will be forced through the valve, F, into the receiver. The slide-valves, N, N, being, by means of the two stems *n*, *n*, previously so placed that the passages, *l*, *l*, are open, the air from the receiver will pass through the wires in L, into the heater, H, and further into C, the temperature of the air augmenting, and its volume increasing as it passes through the heated wires and heaters. The smaller volume forced from A, will, in consequence thereof, suffice to fill the larger space in C. Before the piston arrives at the top stroke, the valve J, will be closed, and at the termination of the stroke the valve, K, will be opened; the pressure from below being thus removed, the piston will descend, and the heated air, in C, will pass through $k^1$, *p*, P, and *m*, into the regenerator, M, and in its passage through the numerous small spaces or cells formed between the wires, part with the caloric, gradually falling in temperature, until it passes off at $o^1$, nearly deprived of all its caloric. The commencement of the descent of the piston, *a*, will cause the valve, F, to close, and the valve, E, to open, by which a fresh charge of atmospheric air is taken into the cylinder, A. At the termination of the full down-stroke the valve, K, is closed, and the valve, J, again opened, and thus a continued reciprocating motion kept up. It will be evident that, after a certain number of strokes, the temperature of the wires or other matter contained in the regenerators will change, that of M will become gradually increased, and that of L diminished. The position of the slide-valves, N, N, should, therefore, be reversed at the termination of every fifty strokes of the engine, more or less, which may be effected either by hand or by a suitable connexion to the engine. The position being, by either of these means, accordingly reversed to that represented in the drawing, the heated air or other medium passing off from C, will now pass through the partially-cooled wires in L, whilst the cold medium from the receiver will pass through the heated wires of M, and on entering H, will have attained nearly the desired working temperature. In

this manner the regenerators will alternately take up and give out caloric, whereby the circulating medium will principally become heated, independently of any combustion, after the engine shall have been once put in motion.

Having thus with special reference to fig. 1, described the manner of putting the improved engine into operation, I have now to notice that the said engine as represented in fig. 2, is operated precisely in the same manner, excepting that the regenerator is arranged in a single vessel, and that the metallic substances therein take up the caloric from the circulating medium that leaves the working cylinder or vessel, c, and returns the same to the circulating medium that enters the working cylinder at each stroke of the engine, instead of transferring and re-transferring the caloric at intervals, as shown in fig. 1. The manner in which the differential or useful upward force of the working piston, *b* (fig. 2), in conjunction with its descending power, caused by gravity, is made to impart rotary movement to the crank-shaft, *x*, becomes self-evident on examining the disposition of the working-gear of the engine, as shown in the drawing. It is particularly worthy of notice that the relative diameter of the supply and working cylinder will depend on the expansibility of the acting medium employed; thus, in using atmospheric air or other permanent gases the difference of the area of the pistons may be nearly as two to one, whilst in using fluids, such as oils, which dilate but slightly, the difference of area should not much exceed one-tenth. I have next to notice that in employing any other medium than atmospheric air, it becomes indispensable to connect the outlet pipe, $o^1$, and the valve-box, *e*, of the outlet valve, E, as indicated by dotted lines in both figures; these dotted lines representing the requisite connecting pipe. The escaping air or fluid at $o^1$, will, when such a connecting pipe has been applied, furnish the supply cylinder independently of other external communication, and the acting medium will perform a continuous circuit through the machine under this arrangement, the operation being, in other respects, as before described. It is evident that the several parts composing the improved engine may be arranged in various ways, and that the external form thereof may be greatly changed, whilst its principle of operation remains substantially as I have ascertained and described. It is also evident that the working cylinder may be placed horizontally or otherwise, and that it may be made double acting, and that a heat-intercepting vessel may be applied at each end of the working piston, as also an expansion-heater at each end of the working cylinder. I do not, therefore, confine myself to the exact form represented in the drawing, but I claim as the invention the substantial feature of the devices I have described as new, and by which I secure great and beneficial results; and particularly I claim as the invention:

First, I claim the structure which I call the regenerator, by which I effect a transfer of the caloric contained in the air, or other circulating medium, that passes off from the working cylinder to a series of disks of wire-net or to other minute metallic or mineral substances, for the purpose of being again transferred to the air or other circulating medium that enters the working cylinder, whether said structure be so arranged that the metallic or mineral substances are made to take up and again return

the caloric at each successive stroke of the working piston, as in fig. 2, or whether it is so arranged that the transfer and re-transfer of the caloric takes place at intervals, as in fig. 1, or whether said structure is arranged in any other manner for the purpose of accomplishing substantially the purposes hereinbefore mentioned.

Secondly, I claim the combination of the expansion heater with the working cylinder, by which the fall of temperature consequent upon the expansion of the air or other circulating medium during the upward movement of the working piston becomes restored, and by which also the force of the said piston becomes augmented beyond what it would be if the accession of caloric effected by the expansion heater did not take place.

Thirdly, I claim the heat-intercepting vessel attached to the working piston, by which any injuriously high temperature is prevented from reaching the packing of said piston, and by which also the very desirable end is attained of presenting at all times surfaces of uniform high temperature to the acting medium under the working piston.

Fourthly, I claim the inverted position and open ends of the working and supply cylinders, as represented in the drawing.

Fifthly, I claim the direct attachments of the working and supply pistons, by which not only the acting and reacting forces may be uniformly distributed over the area of each piston, but by which also the entire differential power of the working piston is rendered available, less only the friction of the packings.—In witness, &c.

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## *Cost of Railway Bars.**

"Mr. Brunel," says *Herapath*, "has lately completed the contract with the Rhymney Iron Works for many thousand tons of rails, at the low figure of five guineas per ton, delivered, for one of the Exeter railways. The rails are to be guaranteed for five years, and one hundred tons to be deposited with the company for that period as security against breakages and failures. Who will not make railways now?"

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## *The Eastern Counties Railway.†*

The statistical details of this line show that the company "has spent in the formation of its various lines the really gigantic capital of 12,998, 207*l.* 2s. 2d., and that it possesses 326 miles of railroad, over which 1,734,390 persons were carried in the six months ending January 4th, 1851. The classification and revenue arising from this one and three-fourths of a million of passengers were as follows:—

| | Number. | £ | s. | d. |
|---|---|---|---|---|
| 1st Class Passengers, | 226,714 | 63,386 | 9 | 5 |
| 2d Class Passengers, | 801,541 | 83,733 | 19 | 1 |
| 3d Class Passengers, | 706,135 | 54,360 | 10 | 8 |

Giving a total amount of 201,480*l.* 19s. 2d.; in addition to which the company received for the carriage of parcels 15,392*l.* 12s. 6d.; goods,

* From the Builder, No. 436. † Ibid, No. 435.

including coals, &c., 140,172*l.* 15s.; cattle, 19,818*l.* 14s. 5d.; mails, 8,591*l.* 14s. 1d. Forming, with other minor sources, a revenue of 400, 552*l.* for half a year, or an annual income of upwards of 800,000*l.*—an income much larger than that of many a continental state. This was accompanied by an expenditure of 225,347*l.* 17s., distributed as follows: locomotive expenses, 82,587*l.* 13s. 4d.; maintenance of way, 34,871*l.* 5s. 3d.; miscellaneous working expenses, 86,461*l.* 1s. 8d.; rates and taxes, 12,869*l.* 7s. 7d.; Government duty, 8,558*l.* 9s. 2d.; total, 225, 347*l.* 17s.: leaving a profit of 175,204*l.* 6s. 11d. on the half-year's work; which balance, nevertheless, was only sufficient to yield a very small dividend available to the original shareholders; but the prospect of a better result is encouraging."

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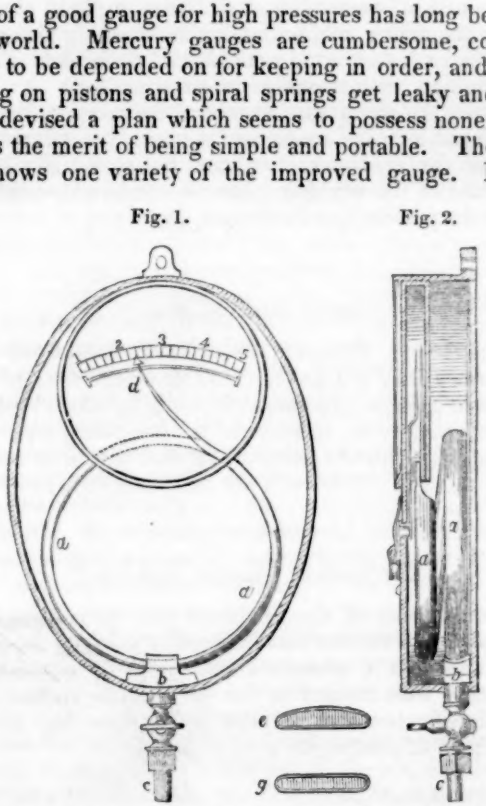
### *Bourdon's Patent Pressure Gauges.**

The want of a good gauge for high pressures has long been felt in the engineering world. Mercury gauges are cumbersome, compressed air gauges never to be depended on for keeping in order, and all the varieties depending on pistons and spiral springs get leaky and stick. Mr. Bourdon has devised a plan which seems to possess none of those defects, and has the merit of being simple and portable. The accompanying sketch shows one variety of the improved gauge. Its action de-

Fig. 1. Fig. 2.




pends on the fact that a thin metal tube of such a section as *e* or *g*, if coiled up and subjected to internal pressure, will tend to uncoil itself in proportion to the amount of the pressure.

*From the London Artizan, for July, 1851.

Fig. 1 is a front view partly in section, and fig. 2 a side view in section of the gauge. *a a* is the coil of tube fixed at one end to the socket *b*, into which the steam is admitted by the pipe and cock *c*. The other extremity of the tube *d*, is provided with an index, which points to the scale on the dial plate. A second index is provided, as shown in fig. 2, by adjusting which by hand, any fluctuation of the pressure may be conveniently noticed. One of these gauges will be found in the machinery department of the Exhibition, attached to the compressed air receiver on Cunningham and Carter's Atmospheric Railway.

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### *Survey of India.**

The trigonometrical survey is at present conducted by seven parties, employed as follows:—Two parties in the Punjaub; one partyin extending the great longitudinal series from Calcutta to Kurrachee, in Scinde; one party on the coast series from Calcutta to Madras, the results of which will be most important to maritime geography; one party employed on the Harelaong series in Behar, if possible to be extended into Nepaul; one party employed in Bengal on the Parasnath series; one party employed in the Bombay presidency. The conclusion of the trigonometrical survey may be expected in six or seven years. The grand total of area triangulated amounts to 477,044 miles, and the total cost to 312,389*l.*

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### *Roofing the Britannia Tubular Bridge.*†

In consequence of the upper surface of the tubes receiving and being acted on by the wet and atmospheric action, it has been deemed advisable to roof the top of the tubes; a complete ridge has been placed over both the tubes, having a walk down the centre, and the framework has been completely covered over with cloth impervious to the rain. Upwards of 7000 yards of this prepared cloth are required. The large hotel which it has been determined to erect adjacent to the bridge will contain 500 beds, and will be connected with the tubes by a covered walk, and surrounded with appropriate gardens and pleasure grounds. The works are in full operation; large bodies of laborers are employed leveling the ground and forming the foundation.

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## AMERICAN PATENTS.

*List of American Patents which issued from August* 12, *to September*, 9, 1851, (*inclusive,*) *with Exemplifications by* Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

20. For an *Improvement in Machines for Cleansing Wool;* Leander W. Boynton, South Coventry, Connecticut, August 12.

*Claim.*—"What I claim as my invention, is the combination of the tub with the shaft and tube, when these are combined with the vat, (with its trough,) and the whole is con-

* From the London Architect, for July, 1851. † Ibid.

structed, arranged, combined and operated substantially as herein described, for the purpose of cleansing, or for coloring wool and other analogous substances, as herein described."

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21. For *Improvements in Machines for Jointing Staves;* Lewis S. Chichester, Williamsburgh, New York, August 12.

*Claim.*—"What I claim as my invention, is combining with the adjacent ends of any two plates of the chain, the hinged pieces provided with self-acting toes, for clamping the stave while it is being jointed, and then releasing it, substantially in the manner and for the purpose described."

---

22. For *Improvements in Spike Machines;* Mark M. Ison, Etowah, Georgia, August 12.

*Claim.*—"Having thus described my invention, I do not claim the header, or the holding die, irrespective of their arrangement and operation; but what I do claim as new, is the arrangement of the carrier within the hollow table, substantially in the manner described; and also the combination of a carrier, so arranged with a single griping die, arranged with respect to it, in the manner substantially as shown; the die and the carrier assisting each other in holding the spike, while being headed."

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23. For an *Improved Water Guage for Steam Boilers;* Azel S. Lyman, City of New York, August 12.

*Claim.*—"I claim the combination of the glass tube and a reservoir of fluid below it, heavier than that contained in its upper part, with the legs of a syphon, so that they become a part of that syphon, substantially as described, by which means I am enabled to protect the glass tube from the heat of the steam and impurities of the water; and also to show, at any point above the boiler, the height of the water in the boiler.

"I also claim the combination with the gauge of the sediment depositor, constructed and arranged substantially as described, for the purpose of preventing the impurities of the water from entering the tube leading to the gauge."

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24. For an *Improvement in Machines for Numbering the Pages of Account Books;* John M'Adams, Boston, Massachusetts, August 12.

"The object of my machine is to effect the paging of account books, which has heretofore been done exclusively by hand, in an expeditious and accurate manner, so that the pile of sheets, for a book of any number of quires, may be passed through the machine, and have the number of each successive page printed in any colored ink, in proper position, in the upper corner of each margin of the sheet, and on both sides."

*Claim.*—"Having thus described my new machine, I shall state my claim as follows: What I claim as my invention, is, 1st, the use of type chains in a machine for printing the pages of account books; and second, a machine for paging account books, having the essential elements herein above described, viz: the imprinting cylinders and rollers, against which they bear, together with the type chains, arranged together, substantially in the manner herein above described."

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25. For an *Improvement in the Manufacture of Pigments;* Hugh Lee Pattinson, Scotts' House, England, August 12; patented in England, February 14, 1849.

*Claim.*—"I therefore, do not claim this composition of matter; but what I do claim as my invention, is the new manufacture of either a white or colored pigment, by the addition of one half of an equivalent of lime, or other earthly or alkaline base, with one equivalent of chloride of lead, or chloride of lead diffused in water, or however the solution may be obtained; the whole being substantially as herein specified."

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26. For an *Improvement in the Method of Forming Teeth upon Cast Iron Grinders;* Ezra Ripley, Troy, New York, August 12.

*Claim.*—"I do not claim the casting of ribs or floats, but what I do claim as my invention, is the mode herein subtantially described, of making or forming teeth or grinders

upon surfaces of cast iron, by nicking, cracking, or chipping out parts of ribs, or floats, cast thereon, so as to leave the teeth or grinders projecting, as above set forth."

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27. For an *Improvement in Sewing Machines;* Isaac M. Singer, City of New York, August 12.

*Claim.*—"What I claim as my invention, is giving to the shuttle an additional forward motion, after it has been stopped, to close the loop as described, for the purpose of drawing the stitch tight, when such additional motion is given at and in combination with the feed motion of the cloth, in the reverse direction, and the final upward motion of the needle as described, so that the two threads shall be drawn tight at the same time, as described.

"I also claim controlling the thread, during the downward motion of the needle, by the combination of a friction pad, to prevent the slack above the cloth, with the eye on the needle carrier, for drawing back the thread, for the purposes and in the manner substantially as described.

"I also claim placing the bobbin, from which the needle is supplied, with thread on an adjustable arm attached to the frame, substantially as described, when this is combined with the carrying of the said thread through an eye or guide, attached to, and moving with the needle carrier, as described, whereby any desired length of thread can be given for the formation of the loop without varying the range of motion of the needle, as described."

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28. For an *Improvement in the Construction of Roofs;* Francis Wilbar, Roxbury, Massachusetts, August 12.

*Claim.*—"What I claim as my invention, is the above described peculiar arrangement of the arched trusses or framing of my improved roof, in combination with the suspending of both inclined sides of the roof, from the ridge timber, so that each inclined side shall be made to counterbalance the other inclined side, and, by so doing, operate to prevent lateral and horizontal thrust upon the side walls; all essentially as specified."

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29. For *Improvements in Sewing Machines;* Allen B. Wilson, Watertown, Connecticut, August 12.

*Claim.*—"What I claim as my invention, is, 1st, the combination of the rotating hook, to extend the loop on one thread, with a reciprocating bobbin to carry the other thread through the loop so extended, for the purpose of interlacing the two threads together, whether the parts be severally arranged and operated as herein set forth, or in any other way substantially the same.

"2d, The hollow mandrel, constructed substantially as herein set forth, with a groove on its periphery, to give a reciprocating motion to the bobbin, a segmental screw thread to feed the cloth forward as the sewing progresses, and a hook and groove on its extremity, to form loops on the needle thread; in combination with a reciprocating bobbin, the whole arranged and operated substantially as herein set forth."

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30. For an *Improvement in Shoulder Braces Combined with Abdominal Supporters;* John S. Dare, Knightstown, Indiana, August 12.

"The principal object of my invention is so to arrange a brace for the shoulders, or other parts of the human frame, as to afford a firm, yet elastic support, without obstructing the circulation, or interfering with any of the vital functions, or movements of the limbs, and it is in the herein described peculiar arrangements of construction, for the attainment of these objects, that the feature of useful novelty exists."

*Claim.*—"Having thus described the nature of my improvements, what I claim therein as new, is, 1st, the bars having a common point of junction to a centre bar at the back; passing thence under the arm pits, and thence forward, upward and backward, until their padded extremities bear upon the clavicle; the bar being so formed as to fit snugly, without direct pressure upon the body, except at the points at front and back, as herein explained, giving the desired support to the shoulders, without unnecessary confinement of the person, or obstruction of its various functions, and at the same time affording through the medium of the bar, a firm point of attachment and support for a uterine or abdominal supporter.

"2d, The jointed bar having pads located on each side of the spine, at the junction of the said bar with the braces, the said bar being jointed midways, so as to admit of easy flexion sideways, without compromising the rigidity which is necessary in other directions, and affording by the limited extent of its pressing surfaces, free scope to the circulation, perspiration, muscular action, and other bodily functions."

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31. For an *Improvement in Ventilating and Excluding Dust from Rail Road Cars;* Ransom Cook, Saratoga Springs, New York, August 19.

*Claim.*—"What I claim as my invention is, the combination of the blower bellows or forcer, with the pipes or tubes for conveying the pure air along the train of cars, the pipes or apertures for the admission of air into the cars, the valves or inverted muffles for controlling such admission of air, together with the valves and apertures for regulating the atmospheric pressure within the cars, and its escape from them; all as herein before set forth."

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32. For an *Improvement in the Manufacture of Brushes;* Abbot R. Davis, East Cambridge, Massachusetts, August 19.

*Claim.*—"What I claim as my invention, is the above described improvement in the manufacture of brushes, the same consisting in laying two or more brush blocks or plates together or upon one another, and either boring them before or afterwards, and each with the same number of holes, and so that each hole in each block shall be in range with a hole in each of the other blocks; and passing or inserting bunches of bristles through all the blocks, and fastening the ends of said bristles in the last block through which they are made to enter, and separating the said blocks asunder, and cutting the bristles between the blocks, all substantially as herein before set forth."

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33. For an *Improvement in Cooking Stoves;* Hosea H. Huntley, Cincinnati, Ohio, August 19.

"My object in this stove is to attain even baking and cooking in both ovens at the same time, leaving the boiler flue in the enjoyment of the full action of the fire."

*Claim.*—"Having thus fully, clearly, and exactly described my improvements in double oven cooking stoves, what I claim therein as new, are the closed chambers, and opening in connexion with the space between the hearth plate, fire back, and boiler flue plate and the upper portion of the ovens at their plates; the whole being arranged substantially in the manner and for the purpose described."

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34. For an *Improvement in Brick Machines;* Richard Long, Columbus, Ohio, August 19.

*Claim.*—"What I claim as new in my invention, is, 1st, the mode of controlling the operation of the mould bed carriage, and driving it in either direction by the combination substantially as described, of the toothed wheel on the mud mill shaft, the rack bars and their racks, and arms or ears attached to the carriage, and the slides on the stationary framing.

"2d, The mode of operating the cut-off plate for the purpose of opening and closing the apertures communicating between the mud mill and the moulds, by means of the levers attached to them, and to the framing, in combination with the wheels on the mould bed carriage, substantially as herein shown."

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35. For an *Improvement in Cooking Ranges;* Nicholas Mason, Roxbury, Massachusetts, August 19.

"The nature of this invention and improvement consists in combining and arranging a series of boilers, ovens, flues, dampers, and their necessary attachments, in such relation to each other and the fire chamber as to form a compact and convenient cooking range, capable of supplying all the wants pertaining to the culinary department, as well as to form a heater for the rooms of the house in which it is situated, with a slight amount of fuel, considering the benefits accomplished."

*Claim.*—"I do not claim to be the inventor of brick ovens, but what I do claim as my invention is the attachment of a brick oven to cooking ranges, to be heated from the same fire with which the cooking is done, as herein described.

"2d, I also claim the hot air chamber at the sides of the perpendicular plates, and extending as high as horizontal plate *i*, and all over curved plate *i i*, and extending all around inclined pipe **F**, and perpendicular pipe *i* **F**, and communicating with pipes J, in the manner and for the purpose herein set forth."

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36. For an *Improvement in Chemical Processes for Fulling Vegetable and other Textures;* John Mercer, Oakenshaw, England, August 19. Patented in England, October 24, 1850.*

"My invention consists in subjecting vegetable fabrics and fibrous materials, cotton, flax, &c., either in the raw or manufactured state, to the action of caustic soda, or caustic potash, dilute sulphuric acid, or chloride of zinc, of a strength and temperature sufficient to produce the new effects, and to give the new properties to them, which I have hereafter described."

*Claim.*—"And I claim as of my invention, the process of fulling cotton, linen, and other vegetable fibrous materials, either in the fibre or any stage of its manufacture, or either alone or mixed with silk, woolen, or other animal fibrous material, by means of astringent or styptic materials, as set forth."

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37. For an *Improvement in Registers for Omnibus Drivers;* Ira B. Person and Joel L. Brockett, Baltimore, Maryland, August 19.

"The nature of my invention consists in arranging one or more doors, legibly numbered, in a frame, in such a manner that persons paying such specific sums are required to open and pay the same through said doors, and attaching such machinery to such door or doors that it and they, respectively, will, upon being so opened, register in the same manner, hereinafter described, the number of such specific sums so paid during any given time."

*Claim.*—"What we claim as our invention is, the arrangement of a series of doors, with the attachment to the axes or hinges thereof, of levers or other mechanism, in such a manner, and in such connexion by means of a rod or rods and springs, or other suitable contrivance or device, with a dial or some like mechanism, that each door, upon being opened, will act upon this dial or other mechanism in such manner as to indicate thereon and thereby the number indicated by such door, the several doors indicating different numbers respectively. Also, the arrangement of a strip of metal or other suitable substance, vertically, or in some other position, in connexion with such dial, so that by means of a wedge upon the dial, and pins upon said strip, or *vice versa*, under which, or over which the wedge successively passes, the said strip will rise, or be forced outward from the circumference of the dial a given distance at each revolution of the dial, and indicate by the figures on the surface of such strip near the outward or upward end of the same successively coming in sight above or beyond the circumference of the dial, the number of such revolutions of the dial, using for the construction of the same any metal or metals, or other substance of a suitable or durable description."

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38. For an *Improvement in Boot Crimps;* Hartwell Stanley, Wilmington, Vermont, August 19.

*Claim.*—"What I claim as my invention, is the lever, the knob, the bolt, and the two circular rods, in combination with each other, and with the other parts of the machine, as described, for the purpose of drawing the corners of the front to their proper place at the same time the brake is passing down over it, by turning the screw, and I make no further claim."

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39. For an *Improvement in Pulp Screens;* George West, Tyringham, Massachusetts, August 19.

*Claim.*—"What I claim as new, is the application of the vibrating bottom or bellows to the box, said box being constructed, as described, with the partition, and the screen

* For specification of this patent, see page 202.

upon its upper surface, by which arrangement the pulp is forced by atmospheric pressure between the plates of the screen upon the partition, and off the partition into a receiving box, substantially as described."

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40. For an *Improvement in Ships' Model Measurer;* Abijah S. Hosley, City of New York, August 19.

*Claim.*—"What I claim as new in my invention is, the employment for the purpose of taking the dimensions of models of ships, and all other vessels, of a pillar or post, having a graduated scale on one side, and an adjustable rest sliding on it, and having also a rule with any number of graduated scales on its face and leg connected with it, both the rule and leg being capable of adjustment in lines at right angles to the face of the pillar or post, the whole being constructed and operated in the manner substantially as set forth."

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41. For an *Improvement in Washing Machines;* David Allan, St. Louis, Missouri, August 26.

"The object of my invention is to provide a machine which will expose the clothes, at every plunge into the cistern or box, to a violent stream of water and suds, which will penetrate every part of them. The usual difficulty of washing machines, so far as my experience goes, is, that the outside ones may be perfectly washed, while the inner ones are scarcely benefitted by the operation."

*Claim.*—"Having thus fully, clearly, and exactly described the nature, construction, and operation of my improvements in washing machines, what I claim therein as new, is, the chamber or tub with its narrowed neck, and otherwise constructed substantially as described, in combination with the plunger, which latter, with the clothes wrapped around it, passes through the narrowed neck of the chamber, and pressing forcibly on the water confined within the body of the chamber, drives it violently in the direction of the arrows and through the body of the clothes, carrying the dirt with it."

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42. For an *Improvement in Cabbage Cutters;* Hiram Carver, Edinburgh, Virginia, August 26.

"The nature of my improvement consists in furnishing an oblong box, (provided with two parallel knives, secured obliquely in the top thereof, with their cutting edges in right and left positions,) with a horizontal, reciprocating feeding box, provided with a vertical feeder, having handles connected therewith, by which the operator lays hold and actuates the feeding box over the knives, and at the same time rendering it self-feeding."

*Claim.*—"Having thus described my improvement on the machine for mincing cabbage, what I claim therein as new, is, the two vertical bars, confined to the sides of the feeding box, so as to rise and fall with the movement of the feeder, said vertical bars having handles, by which the operator actuates the feeding box, and by the same exertion of his arms, renders the material self-feeding, simultaneously with the reciprocating motion of the box."

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43. For an *Improvement in Self-acting Cheese Presses;* Bethuel Gillett, and Lyman Allis, Hartford, Connecticut, August 26.

"The nature of our invention consists in the peculiar combination of a falling press frame, with a pair of toggle joint levers, and an eccentric shaped wedge, fixed perpedicular, as shown in plan."

*Claim.*—"What we claim as our invention is, the combination of the falling frame, with the toggle joint levers, and the fixed eccentric wedge, acting together, and making the upward movement and pressure, substantially as herein set forth and described."

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44. For an *Improvement in Dental Hydraulic Cups;* James Harrison, Jamestown, New York, August 26.

*Claim.*—"What I claim as my invention, is, the construction of said machine, of two or more plates, with vacancies between the same, and with pipes annexed thereto.

"And also, I claim as my invention, the application of water, or any suitable liquid, to the space or vacancy between the plates, for the purpose of hardening and rendering more firm, the contents of the cup, while on the jaw.

"I claim nothing for the outward form of the said plates, nor for the application of the same to the mouth, merely to take impressions; and I also claim as my invention, the method of using the gate as described."

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45. For an *Improvement in Rotary Harrows;* Jonathan F. Ostrander, Assignor to A. B. & C. E. Hutchins, City of New York, August 26.

"The nature of my invention consists in making a rotary harrow, for breaking or harrowing the ground by means of a spur or toothed wheel, arranged so as to turn or roll forward in the open centre of the harrow frame, when being drawn forward by the horses; and as it rolls forward, by means of a small cog-wheel on the end of the shaft of the spur wheel, gearing into a face cog-wheel on the harrow frame, causes it to rotate simultaneously with its forward motion."

*Claim.*—"Having now described my invention and the operation of the same, I will proceed to state my claim as follows: what I claim, therefore, is the use of the combination of the spur wheel with the hollow axis, for the purposes and in mode of construction substantially as herein set forth; and their combination with the circular frame, having the face cog wheel and arms attached, for the purpose of producing a rotating harrow, substantially in principle of construction as herein set forth."

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46. For an *Improvement in Padlocks;* George McGregor, Robert Lee, and Thomas G. Clinton, Cincinnati, Ohio, August 26.

*Claim.*—"Having thus fully, clearly, and exactly described the nature, construction, and operation of our improved mail-bag spring and safety padlock, what we claim therein as new, is, the combination of the bolt *p*, and cavity *y*, on the rotating end of the hasp, with the tumblers *a* and *g*, having the characteristics described, or their equivalents; the tumblers, hasp, and bolt, constituting a system of fastenings within and without the casing of the lock; the whole being arranged and operated, substantially in the manner and for the purpose described."

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47. For an *Improved Adjustable Tool Haft;* Peter H. Niles, Boston, Massachusetts, August 26.

"The nature of my invention consists in the mode of closing the jaws of the gripe."

*Claim.*—"I do not claim the gripe as any novelty, but what I do claim as my invention is, the mechanism by which its jaws are closed, the same consisting of the eccentric groove, the pin, and the revolving tube, as described in the above specification, and shown in the accompanying drawings."

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48. For an *Improvement in Insulators for Lightning Rods;* George W. Otis, Lynn, Massachusetts, August 26.

*Claim.*—"What I claim as my invention, is the insulated support and point for lightning rods, consisting of the insulated point and opening in its shank, the insulating cylinder of glass, with its lip or flanch, and the wooden collar for securing the whole to the building, all as described."

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49. For *Improvements in Breech-loading Fire-Arms;* Horace Smith, Norwich, Connecticut, Assignor to Cortlandt Palmer, City of New York, August 26.

*Claim.*—"What I claim as my invention is, operating the breech pin directly by the finger lever, as herein described, in combination with the breech pin and abutting lever, formed and operating substantially as herein described, and for the purpose specified.

"I also claim elevating the charge lifter by the direct contact of the breech pin carrier, with an arm of the lifter lever, and depressing it by the direct contact of the finger lever with the other arm of the said lifter lever, as described."

50. For an *Improvement in Padlocks;* David Tilton, Stoneham, Massachusetts, Assignor to David Tilton and Samuel Sweetser, Boston, Massachusetts, August 26.

*Claim.*—"What I claim as my invention, is the combination of the turning hasp, or contrivance, the tumbler, and the slide, and its projection, or any mechanical equivalents, the whole being made to operate together, substantially as described."

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51. For an *Improvement in Lime Kilns;* Samuel Brown, Berwick, Pennsylvania, August 26.

*Claim.*—"Having thus fully described my invention, what I claim therein as new, is, 1st, so forming the fire space in lime kilns, which are fixed at both ends as to rise gradually from the centre of the kiln, to points above the eyes in each end thereof, substantially as herein described, for the purpose of so distributing the draft and heat as to secure the even burning of the stone.

"2d, I claim dividing the fire space, by a partition wall in the centre, into two chambers, for the purpose of shifting and regulating the heat required in either end of the kiln, substantially as herein described, for the more evenly burning of the stone.

"3d, I claim, in combination with the fire chambers and partition wall, the ash pits a each end of the kiln, connected by a narrow flue, so that when the eye at either end may be closed for shifting the heat, sufficient draft will be kept up from the opposite end of the flue, to allow the fire to burn moderately, without being entirely extinguished, as herein fully set forth."

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52. For an *Improvement in Horizontal Square Piano Fortes;* George Bacon and Richard Raven, City of New York, August 26.

*Claim.*—"What we claim as our invention or improvement, is connecting and combining, in the horizontal square piano forte, in one piece of cast iron, or other metal or metals, the bridge, the brackets, the upper bearing by the flanches, the reverse bearing on the buttons, the application of the long bridge of the horizontal square piano forte, of the method of firmly screwing the whole to the rest-plank by means of the screws, and the application of the diagonal position of the face of the flanch so as to make both strings of each note of equal length, to metal bridges on horizontal square piano fortes, as seen at H, in the manner and for the purpose intended, described in this specification, and seen in the model and drawings by which it is accompanied."

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53. For an *Improvement in Means of Obviating Difficulties arising from Defective Insulation of Telegraphs;* Charles S. Bulkley, Macon, Georgia, August 26.

*Claim.*—"Having thus fully described my improvements in the working of telegraphs, what I claim as new therein is, reversing the connexion of the main wire with the poles of the battery, so that the battery acts in opposition to the battery at the other end of the line, in the intervals between the contacts made by the key in writing, (in place of merely breaking the circuit.) by means of the apparatus and arrangement of wires, batteries, &c., substantially as above described, for the purpose of counteracting the effects of imperfect insulation, as set forth."

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54. For an *Improved Nut and Washer Machine;* Henry Carter and James Rees, Pittsburg, Pennsylvania, August 26.

*Claim.*—"We claim the two punches, moved at the same time with different velocities, and in the same direction, in combination with a die box, within which the nut is formed, substantially as herein set forth."

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55. For an *Improvement in Machinery for Cutting Glass;* John P. Colné, City of New York, August 26.

"My invention relates to an improvement in glass cutting machinery, and is also applicable to the cutting and shaping of crystals, stones, gems, and all articles which are shaped by grinding with gritty substances."

*Claim.*—"What I claim as my invention is, 1st, the combination and arrangement of the several parts for giving the reciprocating and circular movements herein described, that is to say, the combination of the bed plate and revolving plate with the carriage, consisting of the pieces K L M.

2d, "The method of guiding the movements, and adjusting the several parts of the machine, for the purpose of directing the course of the object to be shaped or figured, in passing the edge of the cutting wheel, by means of movable lettered or named stops and gauges, prepared for particular patterns, and applied to the machine as required, the whole being constructed and operating substantially as herein set forth."

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56. For an *Improvement in Self-Acting Blowpipe Lamps;* David W. C. M'Closkey, City of New York, August 26.

"The nature of my invention consists in the application to the ordinary self-acting blow-pipe lamp of a safety valve, and escape pipe, in such a manner as to regulate the pressure of the gas in the gas chamber, and thereby prevent any accident with the lamp, and also in combining with the blow-pipe a cut-off, or stop cock, for the purpose of diverting the current of gas through the escape-pipe, and of regulating the volume of gas passing through the blow-pipe."

*Claim.*—"Having now described the mode of construction and operation of my improved lamp, I will proceed to state what I claim: I claim, therefore, the use of the safety valve and escape pipe, and stop cock, in combination with the blow-pipe of a self-acting blow-pipe lamp, substantially as herein set forth."

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57. For *Improvements in Machinery for Forming Joints of Elliptical Springs;* William T. Richards, New Haven, Connecticut, August 26.

*Claim.*—"I claim the combination of the hollow die, with the lower die, and half circular shears, actuated in the manner substantially as herein described, and for the purposes herein set forth."

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58. For an *Improvement in Cut Nail Machines;* John P. Sherwood, Fort Edward, New York, August 26.

*Claim.*—"What I claim as my invention, is, 1st, in combination with knives, or the equivalent thereof, for cutting blanks sidewise from nail plate, a traveling griping and heading tongs, or jaws, opening and closing in a direction perpendicular to the face of the nail plate, and constructed and actuated substantially as herein set forth, to gripe the blank on its flat sides, without the necessity of turning it upon edge, as is customary with nail machines heretofore constructed, to draw it from beneath the knives, and to hold it while being headed.

"2d, I claim the direct acting knife-stock, with knives secured to its opposite sides in such positions, with respect to the stationary knives, or to each other, that the knife upon one side cuts after the knife upon the opposite side, in combination with a double graded cam, or other equivalent actuating mechanism, which shall cause the cutter bar to descend with two impulses, at each of which one knife acts to cut a nail blank.

"3d, I claim the relative arrangement of the traveling griping jaws and heading tool, the latter being actuated within the former, and traveling with it.

"4th, In combination with two sets of knives, acting alternately, to sever nail plates, I claim a reciprocating griping and heading carriage, which, traveling to and fro between the two sets of knives, gripes, heads, and delivers a nail at each single stroke, in alternate succession, at its opposite extremities, whereby much time and labor are saved; and the machinery to cut a given number of nails, is condensed into a less space."

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59. For an *Improvement in Spike Machinery;* James H. Swett, Concord, New Hampshire, August 26.

"The nature of my invention consists in the raising up of the end of the spike in the die, after being headed, so that the next following blank will be drawn underneath it, and tilt it out of the die, as said blank is drawn forward by the nippers, and which

prevents the possibility of a spike and blank being in the die at the same time, and the consequent breaking up of the machine."

*Claim.*—"Having thus fully described the nature of my invention, what I claim therein as new, is, the method of delivering the spikes from the die, by means of the tilting rod, and the movable nippers, so as to allow the nippers to draw in the succeeding blank underneath the spike, and tip or tilt it out of the die, which prevents the possibility of a spike and blank being in the die at the same time, and the consequent breaking up of the machine."

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### Design for August, 1851.

1. For a *Design for Ladies' Combs;* Aaron Cook, Newtown, Connecticut, August 19.

*Claim.*—"What I claim as new and original, is the design A, placed on the top or upper part of the comb, formed or composed of the series of oblique rings, as herein represented and described."

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### SEPTEMBER.

1. For an *Improvement in Rules for Calculating Interest;* Samuel S. Young, Assignor to John R. Stephen, Eaton, Ohio, September 2.

"The nature of my invention consists in providing a simple mechanical method of performing the most difficult calculations in interest, and the laying of taxes."

*Claim.*—"What I claim as my invention is, the arrangement of parallel slides, substantially in the manner and for the purposes herein set forth; one slider being for units, another for tens, another for hundreds, &c., and each slider being so graduated and numbered as to show through the vertical opening, the same denoting the interest or tax on the numeral figure that appears on the same slider, at the side of the bar, as herein described."

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2. For an *Improved Saw Filing Machine;* Thomas M. Chapman, Old Town, Maine, September 2.

*Claim.*—"What I claim as new, is the swinging frame, constructed as described, and for the purpose specified, viz: by having the arms firmly attached to a rod; the ends of the said rod working freely in holes or bearings in the ends of the arms, which are attached to the horizontal rod, by which arrangement the swinging frame has an up and down motion, owing to the rod turning in its bearings; also a horizontal reciprocating motion, the same as the rod, and a forward and backward motion, by which, with the aid of the file, turning on its axis in the frame, the file may be so adjusted as to operate both upon the front and back of the saw teeth, substantially as set forth."

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3. For an *Improvement in the Method of Securing Wheels to Axles;* Junius Foster, Green Point, New York, and David Marsh, Bridgeport, Connecticut, Assignors to Junius Foster, Green Point, New York, September 2.

*Claim.*—"We do not claim the securing of a hub to an axle by means of a groove around the inner end of the hub, or a bead on the axle; but what we do claim as new and of our own invention, is the application of the cylinder 5, and flanch *f*, on the axle, in combination with the cylinder *e*, flanch 3, couplings 7, keys 12, and coupling box *g*, to retain the plate *d*, of the hub, and allow its rotation between the flanches 3 and *f*, without any tendency to uncouple the hub from the axle, substantially as described and shown."

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4. For an *Improvement in Double Oven Stoves;* Conrad Harris and Paul W. Joiner, Cincinnati, Ohio, September 2.

*Claim.*—"Therefore, having thus fully, clearly, and exactly described our joint invention and improvement in double oven stoves, wherein the front oven extends under the fire-place, or fire-place and hearth, as may be desired; what we claim therein as new, is the damper *a*, constructed and arranged as described, so that one or both ovens may be used at pleasure.

"We also claim the flue between the ovens, substantially as constructed and arranged to communicate directly with the exit flue.

"We also claim projecting the cold air chamber into the flue under the fire-place, and

there discharging the received air so as to protect the oven from being over heated at that point."

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5. For an *Improvement in Moulding and Casting Stereotype Plates;* Charles Hobbs, City of New York, September 2.

"The nature of my invention consists in moulding and casting any given number of stereotype plates at one operation; besides making them more rapidly than can be made by any other known method, it makes them more perfect."

*Claim.*—"What I claim as my invention is, 1st, the moulding, in plaster, of one or more forms of type, wood cuts, medals, &c., at one operation, in air-tight vessels, by means of exhaustion.

"2d, I claim the making of the plaster moulds with two faces.

"3d, I also claim the casting from one or more moulds, in a box sufficiently tight to hold fluid metal, and bringing the face perfect by means of the weight of fluid metal confined above them in column, or otherwise.

"4th, I also claim the grooved wedges for retaining the moulds in their places while casting from them.

"5th, I also claim the non-admission of fluid metal to the moulds until the orifice through which it enters is sunk beneath the surface of the fluid metal, thus preventing the dirt and dross from entering with it."

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6. For an *Improvement in Drying and Oxidizing Colored Goods;* James C. Kempton, Manayunk, Pennsylvania, September 2.

*Claim.*—"What I claim as my invention, is the application of atmospheric pressure, or the mechanical pressure of air, in the coloring of cotton, wool, or other substances; for removing the excess of liquor absorbed from the vat, and for oxidizing or fixing the color by its forced passage through the mass, and by the use of apparatuses, substantially as herein described."

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7. For an *Improvement in Mercury Baths for Photographic Purposes;* John Moulson, Philadelphia, Pennsylvania, September 2.

"The nature of my invention consists in the agitation of the mercury or other substances used immediately previous to the exposure of the photograph impression to its influence, and upon a cooler surface than that of the mercury cup proper, which I generally expose to constant heat, throwing off the said heated surface of the cup, the mercury or other substance, when not intended for use, thereby to cool it and to agitate it, and to prevent its evaporation, or vaporization when not in use; all of which I am enabled to do by means of my 'moving lever cup bath for photographic purposes,' with or without my double plate holding slide."

*Claim.*—"What I claim as my invention, is my moving and movable lever cup, or its equivalent, and bath, for photographic and daguerreotype purposes.

"I claim the agitation of the mercury upon a cooler surface immediately previous to its use in the heated cup (or part of it), for the development of photographic impressions, by means of my movable lever cup, or its equivalent.

"I claim the lever cup, or elongated cup, movable perpendicularly on an axis or centre of motion, which centre of motion need not be confined to a particular part of the cup, but it may be varied and placed in any manner giving and admitting the movement of the cup, but must be so arranged as that the mercury, or other substance, may flow from the heated surface of the cup to the cooler surface of the tube or elongated cup, and *vice versa*, by elevating or depressing the exterior end of said cup.

"I claim the balancing of said lever cup, or its equivalent, on the centre of motion, wherever placed, so that it will remain stationary, when the weight of the mercury, or other substance, is let on to either end of it; that end containing the mercury or other substance used being held down."

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8. For an *Improvement in the Method of Raising Sunken Vessels;* William Irwin, Philadelphia, Pennsylvania, September 2.

*Claim.*—"I claim the combination of the inflatable air receiver, purchase, roller, and wedge, or their equivalents, as herein described, for the purpose of raising and supporting vessels."

9. For an *Improvement in the Construction of Bridges;* Edwin Stanley, Bennington, New York, September 2.

"The nature of my invention consists in making the arch which is intended to sustain the thrusting force of the load, of wood and iron, so combined and constructed as to afford a firm and durable iron bearing for the upper end of the braces and uprights; while I, at the same time, make the principal part of the arch of wood, combining it with the iron portion of the arch in such a manner, that it can, when decayed, be removed in portions and be replaced with new, without destroying any other part of the structure, by which means I am enabled to secure in the same arch the lightness, cheapness, and security of wood, and the durability of iron."

*Claim.*—"What I claim as my invention, is the method above described and shown of making the thrust arches of bridges, that is to say, I claim the arch constructed partly of wood, and partly of iron, when arranged in the manner herein specifically set forth; the iron parts of the arch being constructed in such a manner as to afford a firm bearing for the braces and uprights, with a projecting flanch of sufficient width to shelter the wooden part of the arch as herein set forth, and the wood being bolted upon the sides, under cover of the flanches of the iron, in such a manner that the wood upon one side can be removed and be replaced without disturbing that on the other, the whole being constructed and put together, substantially in the manner and for the purposes herein set forth."

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10. For an *Improvement in the Construction of Violins, &c.;* William B. Tilton, Carrollton, Alabama, September 2; ante-dated April 8, 1851.

*Claim.*—"Having thus described the construction and effect of my improvement of the violin, &c., what I claim as my invention, is the introduction into the body of the instrument of the brace bar, or supporter, constructed of any suitable material, and of any requisite form, between the upper and lower extremities thereof, inserted either into blocks of wood, A and B; or, instead of A, into an elongation of the neck to answer the same purpose, by which means I am enabled to give strength to the instrument, to resist the strain of the strings, and disconnect the sound board, and the table or back from the blocks A and B, said brace or supporter sustaining the tension of the strings, preserving in tune, and also materially improving the tone, in quality, volume, and melody, of instruments to which this improvement is applicable.

"I also claim the manner of increasing the vibration of the sound board, and the table or back, by the cutting away or removing the before described portions of blocks A and B, in the manner and for the purpose set forth in the foregoing specification and accompanying drawings."

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11. For *Improvements in Cider Mills;* Nathan Chapin, Syracuse, New York, September 2.

"The nature of my invention consists in a new method of grinding apples, together with the method of removing the platform of the press for the purpose of disposing of the pumice, after it has been pressed."

*Claim.*—"What I claim as my invention, is the cast iron grinders, arranged and constructed as described, viz: so as to force the apples, while being crushed, from the centre towards the periphery of the plates; and at the same time to force a portion of the pumice through the holes in the lower plate of the grinders.

"I also claim the method of removing the cheese of pumice from the press crib, viz: by detaching the platform from the press crib, and using the same for a sled to draw the cheese from the mill, substantially as described."

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12. For an *Improvement in Circuit Changers for Electro-Magnetic Telegraphs;* Charles S. Bulkley, Macon, Georgia, September 2.

*Claim.*—"Having thus fully described my improvements, what I claim as new therein, is the circuit changer, substantially as above described, in combination with the arrangement of wires, magnets, &c., as set forth, for the purpose of enabling the operator at either one of two distant stations to arrange the connexions at the intermediate stations, so that he can write through to the other end station at pleasure."

13. For an *Improvement in Machines for Making Sod Fence;* H. L. F. Gavett, Jackson, Michigan, September 9.

"The nature of my invention consists in so arranging a series of cutters and mould boards, as that two wedge shaped slices of sod will be cut and gradually turned up upon their broader edges, when they are caught between rollers, so adjusted as to press them close together; the transverse axis of said rollers being inclined, so as to make a lifting and pressing motion in an upward direction, and making at one and the same operation a compact sod fence, with ditches on both sides thereof."

*Claim.*—"Having thus fully described my invention, what I claim therein as new, is, the combination of the cutters and mould boards for cutting and turning the sod on edge, with the inclined adjustable spring rollers, for raising, packing, and forming the sods into a fence, as herein described and represented."

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14. For an *Improved Hook Heading Motion for Spike Machines;* Moore Hardaway, Troy, New York, September 9.

"My improvement consists in the employment of a header, in such a manner, that when the rod of iron shall have been fed into the dies, the header will be made to descend and bend the end of the rod downward, and after a limited pause in the movement of the header, be made to advance horizontally and press said rod against the dies, and thus form the hook head."

*Claim.*—"Having thus described my improvements on the machine for making hook headed spikes, what I claim as new and of my own invention, is, the employment of a header, made to have a descending, and afterwards a horizontal frontward movement, for the purpose of first bending the end of the piece of iron downward, and then forcing it horizontally against the end of the die, and thus form a hook head as described and represented."

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15. For an *Improvement in making Sails;* Eli F. Southward, Wellfleet, Massachusetts, September 9.

"The nature of my invention consists in so arranging the cloths of the square sails, that the whole cloths are at the leeches, and run parallel with the leeches and the goring cloths, all meet in the bunt of the sail, arranging the straight cloths as in plate 1st, figures 2d and 3d, numbered 1, 2, 3, 4, 5, 6, &c., and the goring cloths as in same plate, and figure, numbered 10, 11, and 12."

*Claim.*—"What I claim as my invention is, the bringing straight cloths upon the leeches, and making all the head cloths parallel therewith, and uniting the goring cloths in the bunt of the sail, as described above."

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16. For a *Gold Amalgamator;* William Ball, Chicopee, Massachusetts, September 9.

*Claim.*—"What I claim, therefore, as my invention is as follows: I claim the combination of the partition (dipping below the surface of the water), with the lower distributor, provided at the centre with a discharge aperture for the water and light particles, and at the periphery, with apertures for the discharge of the water and heavier particles, for the purpose of preventing the escape of gold over the central or waste pipe.

"I also claim the arrangement of the sliding tube ferrule, or waste gate, directly upon the hollow axle of the lower distributor, the same being for the purpose of regulating the head of water within the said distributor.

"I am aware that it is not unusual in gold washers, to use a succession of baths; therefore, I do not claim such arrangement in general; but

"I also claim arranging the secondary mercury bath, concentric with and below the primary one, in such a manner, that the currents of water, et cetera, return towards the centre of the apparatus; thereby saving room and causing the said currents to pass more slowly."

---

17. For *Improvements in Equalizers of Power Regulators;* Alfred Gregory, Brooklyn, New York, September 9.

"The nature of my invention consists in causing the steam, gas, or other propelling

medium, contained in the boiler, or reservoir, which supplies the engine, to operate, (in lieu of air under ordinary atmospheric pressure, as heretofore,) upon the piston of the "Equalizer," the said piston being connected with the engine, or other mover, and operating therewith in a similar manner as with former "Equalizers," or in any other appropriate way."

*Claim.*—"I will proceed, distinctly, to state that I do *not* claim the mere employment, as an "Equalizer," or regulator of a piston, operated by, and acting against pressure, alternately, each stroke; the said piston having two strokes for one of the engine or other mover it works in connexion with, as such has already been done; nor do I claim, separately exposing the equalizer piston to the vacuum of the condenser; but what I do claim as my invention, is the use of steam, or other gas, to operate upon the piston of the power regulator, or "Equalizer," the said steam, or gas, being derived from the same reservoir that supplies the engine."

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18. For an *Improvement in Sword Canes;* Samuel A. Hudson, Worcester, Massachusetts, September 9.

*Claim.*—"What I claim as my invention, is a sword cane, constructed substantially as herein set forth, viz: consisting of the rod, with blade attached, passing through the entire shaft, and giving point beyond it, whether the said rod be or be not connected with a spiral spring, to draw the blade back into the handle.

"I do not claim the application of the spiral spring, as an adjusting power, nor do I claim the screw applied as a stop, neither of which being substantially new."

---

19. For an *Improvement in Washing Machines;* Erastus Lawrence, Dublin, Indiana, September 9.

"My invention consists in a system of mechanical devices, which are operated conveniently by hand; and by whose action, clothes and other articles are thoroughly rubbed and turned to be rubbed on different surfaces, or in different positions, in a manner closely resembling the manipulations of the washerwoman, but without being touched by the hand of the operator."

*Claim.*—"What I claim as my invention is, the combination, substantially as described, of the levers, link-bar, and rubbing-board, for the purposes herein specified."

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20. For an *Improvement in Axles of Wheeled Cultivating Ploughs;* G. W. C. Gillespie, Burlington, Iowa, September 9.

"The nature of my invention consists in hanging one or both of the axles of the wheels of the carriages of cultivators, gangs of ploughs, seed drills, etc., to the frame of the carriage, when the ploughs or cultivators are placed diagonally one behind the other, so as to vibrate them by levers, or other means, or suffer them to vibrate of themselves, so as to assume a position at right angles to the track of the wheel, when moving in a straight line, and when turning in a line nearly parallel to the radius of the circle formed by the track of the wheel; so that such carriages and their appurtenances may be turned about with facility, without the risk of breaking the same."

*Claim.*—"What I claim as my invention is, hanging one or both of the axles of the wheels, to the carriages of cultivator gangs of ploughs, seed drills, etc., to the frame of the carriage, so as to vibrate the axle, or axles, or suffer them to vibrate, and keep them at right angles to the motion of the ploughs, when moving in a direct line; and when turning the ploughs, to keep the axle or axles in the direction of the radius of the circle, or nearly parallel with the radius of the circle formed by the track of the wheel turning upon said axle; when the ploughs constituting the gang, are placed diagonally, one behind the other, in succession, and the wheels to the carriage of the same, are also placed diagonally, one behind the other."

---

21. For an *Improvement in Type Casting Machines;* John J. Sturgis, Assignor to H. H. Green, City of New York, September 9.

"The nature of my invention consists in the arranging of a slide rest, for the support of the mould blocks in a frame, so as to have an oblique side inclination, for facilitating the dropping of the type from the mould block, when opened, and a forward horizontal slide

motion, for presenting the mould block to the nipple of the fused metal bath; also, the combining therewith, the mould blocks, and the arrangement of certain levers, for the opening and closing the said mould blocks, and operating or relieving the matrix, all for the purpose of producing a more perfect and expeditious mode of casting printers' type."

*Claim.*—"Having now described my invention and the operation of the same, I will proceed to set forth what I claim. What I claim, is, 1st, the employment of the lever, having an adjusting slot-adjuster, matrix spring holder, and their combination with the horizontal slide, slide ways, and matrix spring, substantially in form and manner, and for the purposes herein set forth.

"I claim also the employment of the adjusting, supporting piece, and the combination therewith of the horizontal slide and levers, substantially, in form and manner, and for the purposes herein described.

"And I also claim the combination and arrangement of the horizontal slide, slide ways, and levers operated thereby, for the purpose of obtaining a horizontal and oblique action of the machine."

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22. For an *Improvement in Piano Forte Action;* Randolph Kreter, City of New York, September 9.

*Claim.*—"What I claim as my invention, is the repeating check, or tongue, connected with a lever, hinged to the hammer rail, and resting on the key; the under side of the hammer but being provided with an arm, which rests against the upper end of the face of the repeating check, substantially as and for the purpose specified."

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23. For an *Improvement in Dental Forceps;* J. C. Burch, Evansville, Indiana, September 9.

*Claim.*—"What I claim as my invention, is, the compound lever forceps, above described; or the compound lever, and the movable fulcrum, applied to forceps, by means of which the roots of decayed or broken teeth may be readily and easily reached, and extracted."

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24. For an *Improvement in Piano Forte Action;* James A. Gray, Albany, New York, September 9.

"The nature of my invention consists in having an independant movable or oscillating shoulder attached to the hammer but for the hopper to act upon, in throwing the hammer against the strings of the piano forte; and also the extension of this shoulder downwards, so as to connect with a spring."

*Claim.*—"What I claim as my invention, is, in having the shoulder under which the hopper plays, attached to the hammer but by a centre pin, forming an independent oscillating shoulder to the hammer but, (said shoulder being usually detached from the hammer but, or composing a part of it.)

"I also claim the extensien of the back part of the shoulder down, so as to connect with a spring."

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25. For an *Improvement in Piano Forte Action;* Robert M. Kerrison, Philadelphia, Pennsylvania, September 9.

*Claim.*—"What I claim as my invention, is the jack, consisting of a crooked lever, and a straight or nearly straight lifter or pusher, acting conjointly on the general principle above illustrated.

"And I also claim the peculiar application of the spring to govern the alternate bending and straightening of the jack, by acting one prong or tooth between two other prongs or teeth, with due allowance of play, or shake, according to the desired degree of drop of the hammers from the string, known as the scape."

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26. For an *Improvement in Fastening Hooks and Eyes to Paper Cards;* Chester J. Carrington, Waterbury, Connecticut, September 9.

*Claim.*—"I claim nothing for the machinery for which the work is done; nor for the

mortise-like holes, which belong to Atwood's patent; but what I do claim as my invention, is the confining of the eye by means of the longitudinal cut, or slit, or cuts or slits, (whether one or more is used,) in the card parallel with the rows of holes, admitting through it or them, a portion of the eye, as herein described and applied, or in any manner, substantially the same."

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27. For *Improvements in Gauges used in Turning;* Chauncey R. Hurlbut, Waukau, Wisconsin, September 9.

*Claim.*—"What I claim as my invention, is the gauge, with its graduated slide, capable of being set to any given diameter, the whole being suspended upon a horizontal wire, and operating as herein set forth."

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28. For an *Improvement in the Manufacture of Paints;* Guillaume Ferdinand de Douhet, Paris, France, September 9. Patented in England, June 1, 1850; in France, October 5, 1850.

"The deoxydation, or loss of oxygen, which is undergone by certain bodies, imparts to them new properties, useful to the arts and industry.

"It is this deoxydation and the applications resulting therefrom that form the object of this invention."

*Claim.*—"What I claim as my invention, is the manufacture, by the processes substantially as herein described, of new colors fit for painting, whether with oil, varnish, spirits of turpentine, or water, by means of the deoxydation of the soluble metallic sulphates of zinc, copper, iron, and other metals, and by the precipitation of their bases, either by alkaline hydrosulphurets, whose sulphates are soluble, such as those of soda, potash, and ammoniac, to obtain colors with a single metallic base; or to obtain colors with a double base, partly metal, and partly alkaline sulphate, by using the alkaline hydrosulphurets, whose sulphates are insoluble, such as those of baryta, of strontian, and of lime, and even by the hydrated sulphuret, and polysulphurets of lime, prepared directly, substantially as herein set forth."

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## MECHANICS, PHYSICS, AND CHEMISTRY.

For the Journal of the Franklin Institute.

### *Notes on the U. S. Steamer "Bibb." By* B. F. Isherwood, *Chief Engineer U. S. Navy.*

The *Bibb* was one of four steamers built in 1843–44, for the Treasury department, with Hunter's submerged wheels. She was the last one constructed on that plan, and cost $145,604·13. The others were the

| | |
|---|---|
| *M'Lane*, . . | 83,338·69 |
| *Dallas*, . . . | 82,952·23 |
| *Spencer*, . . | 105,013·10 |
| Total, | $416,908·15 |

These four miserable abortions were of the same dimensions, viz: 148 feet in length, 23 feet beam, 14 feet hold, having a mean draft of water of 10 feet loaded, and 8 feet light; the mean being 7½ feet forward, and 9¾ feet aft. They cost nearly enough to build a first class steam frigate. The steam frigate *Kamschatka*, constructed at New York for the Russian government, and displacing 2468 tons, cost only $400,000.

The *Bibb's* burthen was, by measurement, 409 tons. She was built at Pittsburg, Pa., and never made but a trial trip with Hunter's wheels. On leaving Pittsburg for the first time, after a vain attempt to stem the current of the Ohio river, so as to display her before the town, she was put about and steamed, or rather drifted down the river for a few hours, when she was found to be fast sinking, the steps of the wheels having become cut out; the water soon drove the engineers from the engine-room, and as a last resort, the vessel was run ashore. The leak was stopped after great detention and expense, and the vessel finally towed down to Cincinnati by a river steamboat, where the Hunter wheels were ordered to be taken out by the disgusted department, and common side wheels, with a single side lever engine, substituted. These necessary alterations were effected at a cost of about $30,000; the vessel has since undergone no further alteration.

The *Bibb*, while used as a revenue cutter, carried an armament of one long iron eighteen pounder, and four iron thirty-two pounders; but, in common with all the steamers built for the use of the Treasury department, she proved wholly unfitted for that service, and like them, has been disposed of for other purposes, the *Bibb* falling to the Coast Survey.

These steam revenue cutters were all very unfortunate in their machinery, which was continually breaking down, causing them to be the greater part of the time laid up for repairs, which were soon found too costly for the value of the vessels' services. They were originally intended to be propelled by steam as an auxiliary power, and to depend on their sails for the most of their cruising; but their sailing was even worse than their steaming qualities; for in order to diminish the resistance of the hulls, so as to obtain a respectable speed from the Hunter wheel, they were made so sharp and crank that they could not carry sail; while in order to obtain a high rate of speed under sail alone, they were so heavily sparred as to be quite unsafe in heavy weather, and fully justified the opinion of Captain Fraser, that the spars would "require great reduction before it is safe to send them (the vessels) to sea."

For revenue purposes, a vessel should not exceed 200 tons burthen, while these were double that measurement, and were yet deficient by about 8 feet of beam to have stability under canvass; in fact, none of these vessels would stand up under canvass, nor could they be *stayed* under ordinary circumstances; while in bad weather it was difficult to *wear* them, or *lay them to*. A fresh wind abeam buried the lea side paddle wheel nearly up to the shaft, and they were altogether unmanageable in a gale at sea.

Notwithstanding that the steam power was intended to be auxiliary to the sails, the machinery occupied so large a space that it was found necessary, in the *Bibb*, to remove the captain's quarters from below to the spar deck.

These vessels was an attempt to do a great deal with a very little. They were to outsail the fastest sailing vessels with sails alone; they were to equal the fastest sea steamers under steam alone; they were to consume almost nothing in coal, and to carry a sufficient amount of that desirable article for an incredible length of steaming. Utterly deaf to the

admonitions of scientific induction and professional experience, the government, listening only to the asseverations of the inventor, went on building failure after failure on this plan; and with singular perseverance, would commence a new vessel on the very same design of one which had just proved an irredeemable failure.

The *Bibb*, like the others of its class, was an iron vessel, and like them, subject to very rapid fouling of the bottom, by the attachment of marine plants and shells; so rapid was the growth of these parasites, that three or four months cruising in the southern waters covered the immersed portion of the hulls with grass of several feet in length, and thick clusters of oysters, barnacles, &c., to the great reduction of the vessel's speed.

The *Bibb* was about 460 tons displacement at mean draft with an immersed amidship section of about 167 square feet. The hull was 143 feet between perpendiculars.

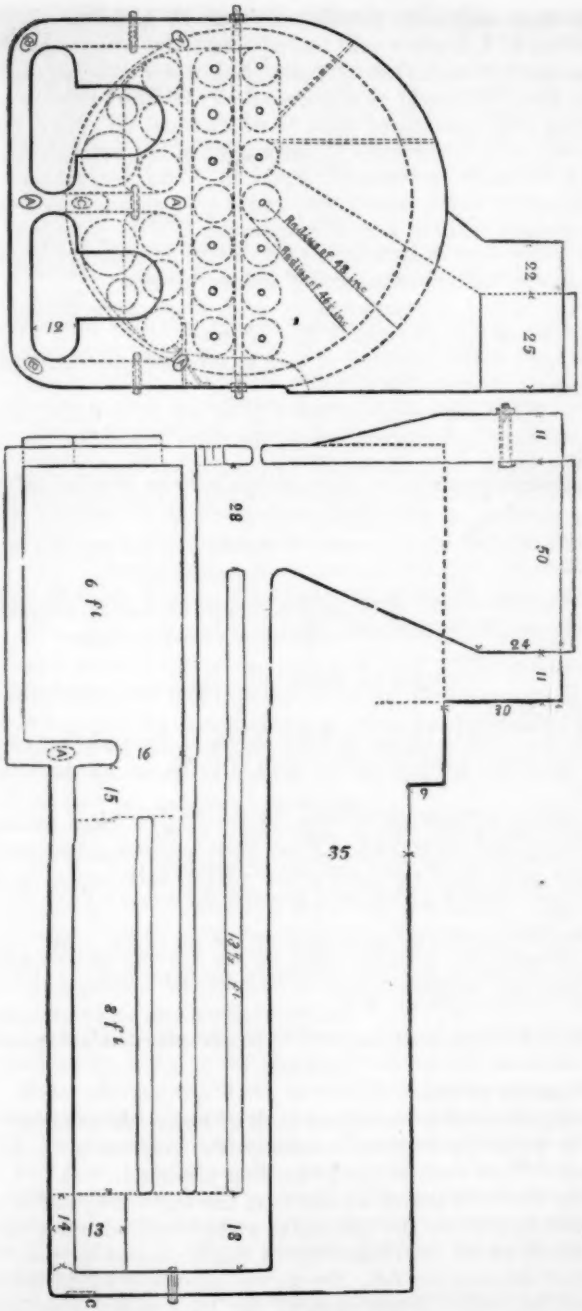
*Engine.*—One side lever; diameter of cylinder 50½ inches; stroke of piston 4 feet 7 inches; capacity of space displacement of piston 63·76 cubic feet.

*Paddle Wheel.*—Of the common radial kind, 16 feet from outside to outside of paddles; 16 paddles in each wheel; length of paddle 7½ feet; breadth of paddle 22 inches; immersion of lower edge of paddle 42 inches at mean draft of vessel.

*Boilers.*—The boilers of the *Bibb* were of iron, two in number, of the return ascending flue kind, furnished with a steam chimney, or drum, around the smoke chimney. The furnaces were 6 feet long, and 3 feet 4 inches wide, containing in the aggregate 80 square feet of grate surface. The lower flues were 15, 9, and 10 inches diameter, the upper ones 9½ inches diameter; and the length of circuit traversed by the heated gases, from their entrance into the flues to their discharge into the smoke chimney, was 21½ feet. Total heating surface in both boilers 1732 square feet. Calorimeter, or cross area of lower flues (in both boilers) 13·21 square feet; of upper flues 13·78 square feet. Area of smoke chimney 13·63 square feet. From these figures it appears that the calorimeter was sensibly the same throughout. The proportions of the boiler would therefore be as follows, viz:—

Grate to heating surface, 1·00 to 21·65; calorimeter, or least cross area of flues to grate surface 1·00 to 6·06; square feet of heating surface per cubic foot of space displacement of steam piston 27·17 to 1·00.

With the above proportions, the boilers generate steam enough to fill the cylinder 38 times per minute with steam of 15 pounds boiler pressure above the atmosphere, cutting off at half stroke; using anthracite coal, with moderate blowing, at the rate of 11 tons per 24 hours. The capacity of the space displacement of the steam piston being 63·76 cubic feet; one-half of it would be 31·88, to which must be added 3·16 cubic feet in the clearance and steam passage between valves and cylinder at one end of the cylinder; making a total of 35·04 cubic feet of steam used per stroke of piston. With 38 strokes per minute this would be 79891·20 cubic feet of steam per hour, and taking the relative bulks of steam of the total pressure of 28 pounds per square inch (which allows the initial pressure in the cylinder to be 1·7 pound less than the boiler pressure, which was


Radius of 48 inc.
Radius of 41 inc.
12
22
25
11
50
24
11
10
9
35
16
15
13
14
18
13 ft
8 ft

about the mean with wide throttle, as shown by indicator diagrams), and water as 941 to 1, there would be required to be evaporated 84·9 cubic feet of water to furnish that amount. Sea water weighing 64·3 pounds per cubic foot, the weight of water would be 5459·07 pounds evaporated per hour by 1027 pounds of coal, to which must be added the loss by blowing off, so as to maintain the saturation of the water in the boilers at $\frac{2}{32}$ of the ordinary hydrometer, equal to 11·93 per cent. of the total caloric imparted to the water; this would give an additional evaporation of 0·72 pounds, making a total evaporation of 6·03 pounds of sea water per hour per pound of anthracite coal: a rate of economical evaporation fully up to the ordinary standard of marine boilers.

With the above consumption of coal, there were burned per hour 12·83 pounds of coal per square foot of grate.

Each square foot of heating surface evaporated per hour 3·58 pounds of sea water.

*Speed.*—The mean speed of the *Bibb* at sea in ordinary weather was 7 knots per hour under steam alone, the wheels making 19 revolutions per minute; steam boiler pressure 15 pounds per square inch, cutting off at half stroke. Paddles dipping 42 inches. The circumference of the centre of reaction of the paddles was 46·34 feet. Taking the knot at 6082$\frac{2}{3}$ feet, the slip of the centre of reaction of the paddles would be as follows:—

$$46{\cdot}34 \times 19 \times 60 = 52827{\cdot}60 \text{ ft.} = \text{speed centre of reaction of paddles per hr.}$$
$$6082\tfrac{2}{3} \times 7 = 42578{\cdot}67 \text{ ft.} = \text{speed of vessel per hour.}$$

$$10248{\cdot}93 \text{ ft.} = \text{slip of centre of reaction of paddles per hr.}$$

or 19·4 per cent.

The loss of power by the oblique action of the paddles, calculated as the squares of the sines of their angles of incidence on the water, is 18·8 per cent.

The power actually developed by the engine when working with a total initial cylinder pressure of 28 pounds of steam per square inch, cutting off at half stroke, and making 38 strokes per minute; taking the back pressure on the piston at 4 pounds per square inch, would be as follows, viz:—

Including the effect of the expansion of the steam in the cylinder passages and clearance, the mean effective pressure will be 19·94 pounds per square inch of piston, and

$$\frac{2002{\cdot}96 \text{ (area of cyl. in sq. in.)} \times 174\frac{1}{6} \text{ (speed of piston in ft. pr. m.)} \times 19{\cdot}94}{33000},$$

$= 210\ 8$ horses power.

Allowing $1\frac{3}{4}$ pounds per square inch of steam piston for the power required to work the engine, overcome the load on air pump, &c., we have, say 8·3 per cent. of the power thus absorbed.

Taking the coefficient of friction from the experiments of Morin at 0·75 of the power applied, and taking the power applied upon the wheel to be the whole power developed by the engine, minus the power absorbed in working the engine, &c., the power absorbed by the friction of the load, will be, say 6·9 per cent. of the total power developed by the engine.

Collecting the above, we have the following disposition of the power in the *Bibb:*—

| | | | | | |
|---|---|---|---|---|---|
| Slip of the centre of reaction of the paddles, | 19·4 | per cent. or | 40·90 | horses power. | |
| Oblique action of the paddles, | 18·8 | " | 39·63 | " | " |
| Working the engine, &c., . . | 8·3 | " | 17·49 | " | " |
| Overcoming friction of the load, . | 6·9 | " | 14·55 | " | " |
| Leaving to be utilized in the propulsion of the hull of the vessel, | 46·6 | " | 98·23 | " | " |
| Totals, | 100 | | 210·80 | | |

All the revenue steamers originally constructed with the Hunter wheel, had, soon after trial, either the common side paddle wheel or screw propeller substituted.

The experiment with the Hunter wheel, though totally valueless, except so far as proving experimentally the absurdity of that system of propulsion, which to any tyro in steam engineering needed no such proof, especially at such a cost as it was obtained, yet may prove valuable if it shall succeed in convincing others that although "all men are born equal in America," yet with a difference, and that gentlemen whose whole lives have been devoted to the study of the law, had better leave questions of engineering to professional engineers.

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For the Journal of the Franklin Institute.

*Notice of a new Steam Engine, Constructed by I. P. Morris & Co., Philadelphia, from Designs, and under the direction of* FRANKLIN PEALE, *Chief Coiner of the Mint of the United States.* (*With a plate.*)

The general design of this engine, (Plate XII.) conforms to the Gothic or pointed style, and its construction is what is commonly known as the steeple engine, working by simple high pressure; there are, however, peculiarities, and as far as is known to us, novelties in construction, which it is thought are entitled to attention.

It will be observed on inspection of the engraving, that it is a combined or double engine, with the cranks at right angles; that it has no fly wheel, properly so called, but a pully or drum, from which the power is carried off by a broad belt (two feet in width). The drum is cast hollow, with chambers in the periphery, into which lead has been run, to counterpoise exactly, the pistons, triangles, pitmen, &c., so that the engine is in perfect equilibrium in every position, and performs its revolutions in an equal and regular manner.

It will be observed, also, that it is perfectly symmetrical in all views, and that there are no steam or exhaust pipes visible on the exterior. A heavy bed plate, serving as a base, of twelve inches elevation, supports the frame and cylinders; it rests upon a brick foundation laid in cement, and secured by strong bolts built in. The steam passages have been cast in the bed plate, to convey the steam to and from the chests and cylinders, which stand vertically upon it. The pipes which convey the steam from the boilers to the engine, are placed in a passage or chamber, built in the foundation, in which chamber the throttle valve, controlled by the governor, is placed.

The cylinders are placed eccentrically, within cylindrical cases, forming *jackets*, the intervening space, being the steam chest, containing the valve

seats, and long slide valves, moved by the eccentrics, which are placed upon the shaft, immediately above; the eccentric position of the outer cylinder or jacket, allowing the required space on one side for the valve, and a sufficient space all round, for the channels and steam.

The cylinders are fitted over one another, with conical metallic joints, and the cylinder covers contain the stuffing boxes of the piston and valve rods.

It is this position and arrangement of double eccentric cylinders, giving space for the valves, channels, and steam, and forming a jacket round the working cylinders, which is claimed as an economic novelty, simple in its form, easy of construction, and presenting on the exterior a plain bright surface, an important security from loss of heat by radiation, or condensation of steam in the interior; and finally, entirely divested of the usual disfiguring appendages of steam channels, pipes, joints, &c.

The piston rods and guides are made of steel, the cross-heads travel upon the latter, with metallic packing of an approved alloy, with tightening screws. The pistons are furnished with what is termed steam packing, in other words, metallic plates, held against the surface of the cylinders by the pressure of the steam.

The triangles or stirrups, connected in the centre of the bow, with the piston rods, are forged in one piece, and are planed up, and finished bright throughout.

A simple solid pitman forms the connexion with the cranks, a double stub-end and strap connecting with the cross-head above, and a single one below, working on the wrist pin.

The shaft and drum are supported on two cast iron frames, which conform in general features to a pointed arch window, strengthened by pannels, and enriched by columns, supporting the pedestals, and carried up to a finial; its exterior being decorated with appropriate crockets. The two frames are connected above the drum, by stays and braces, which are consistent with the style, so arranged as to afford space, within which the governor stands, centrally and appropriately, to regulate the motion of all that is below and around it.

The engine is moved by steam at a pressure of eighty pounds, and is intended to be run at fifty revolutions per minute; this rate of motion is maintained without the slightest vibration, jar, or noise, and is calculated to give a sufficient effective force for all the heavy operations of the Mint. The power is applied, through the agency of belts, to the rolls, and other machinery, silently but efficiently, an evidence that in mechanics, as in moral science, the best effects may be produced with the least noise.

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For the Journal of the Franklin Institute.

## *A Series of Lectures on the Telegraph, delivered before the Franklin Institute. Session*, 1850–51. *By* Dr. L. Turnbull.

Continued from page 194.

### *Wheatstone and Cooke's Needle Telegraph.*

In 1834, Professor Wheatstone published a beautiful series of experiments on the velocity of electricity, which I noticed in the first of these lectures on the Telegraph. This seems to have had an influence in directing his attention to the subject of the Electric Telegraph. During the month of June, 1836, in a course of lectures delivered at King's College,

# COMBINED
# STEEPLE ENGINE,

Designed by **FRANKLIN PEALE**, Chief Coiner.

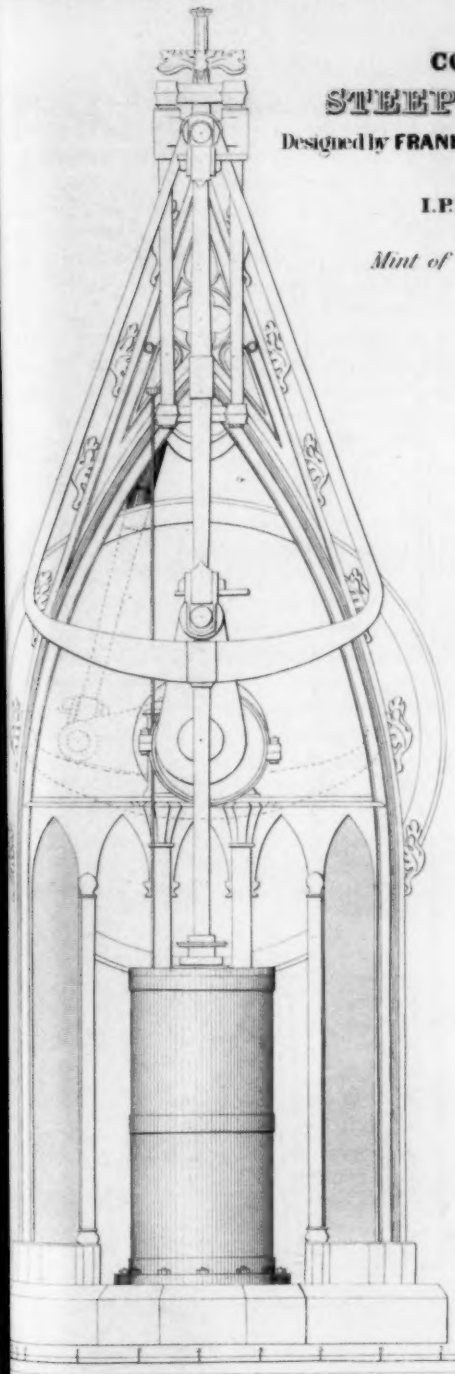
*and made by*

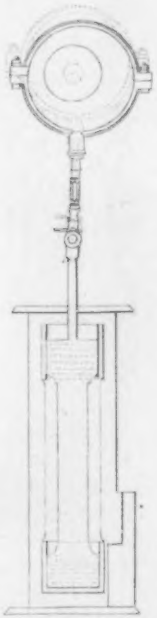
**I.P.MORRIS & Co**

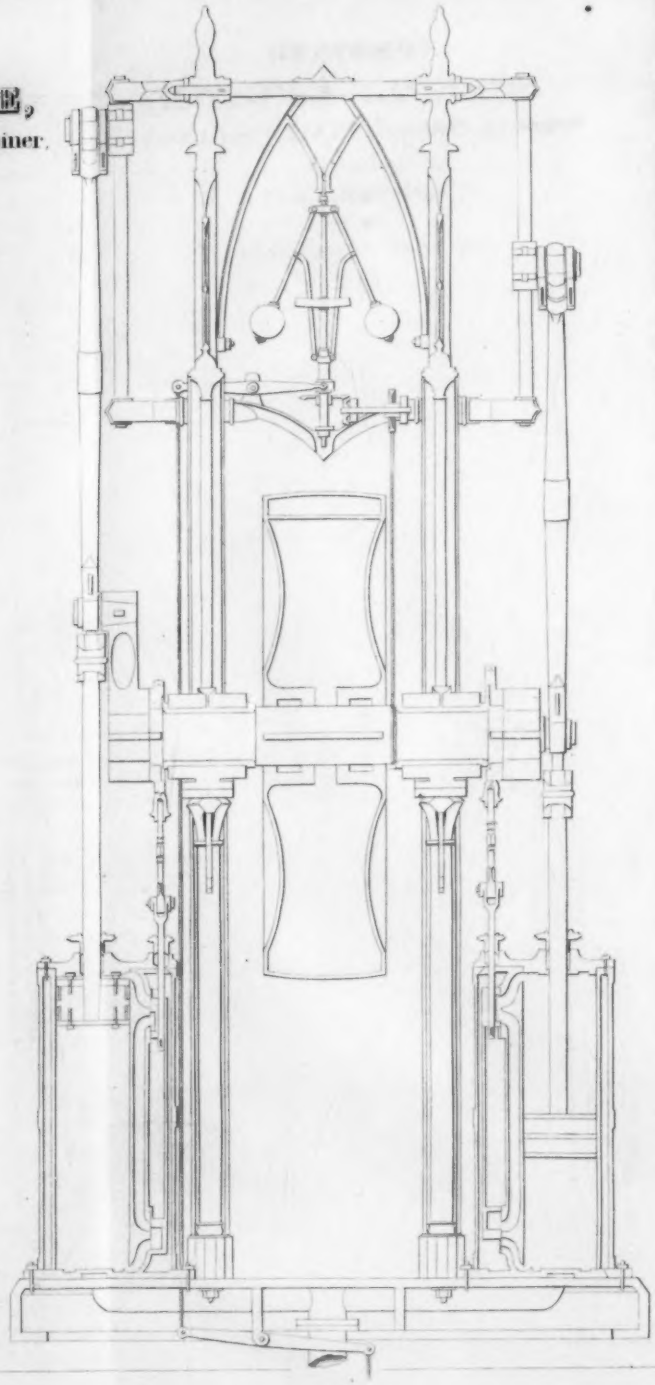
FOR THE

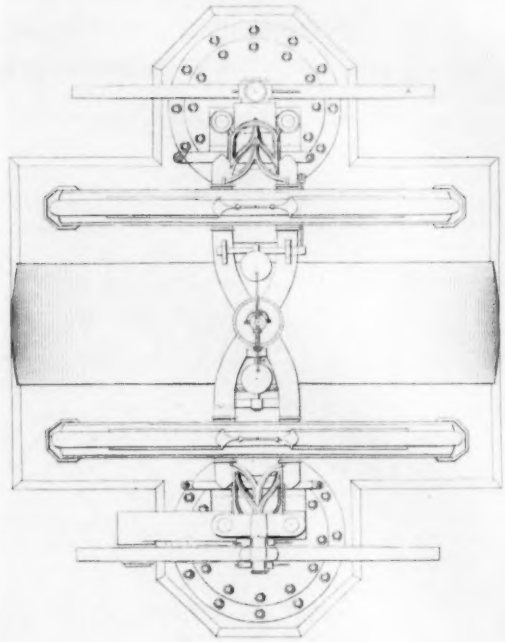
*Mint of the United States,*

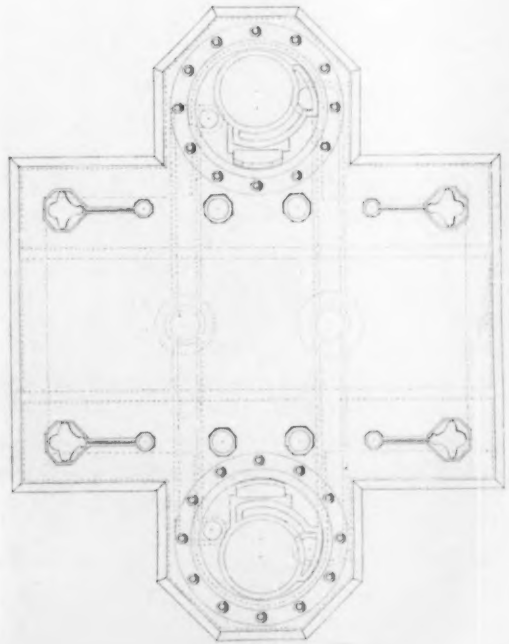
1851.











London, he repeated his experiments on the velocity of electricity, but with an insulated circuit of copper wire, the length of which was now increased to nearly four miles; the thickness of the wire was $\frac{1}{8}$ of an inch.

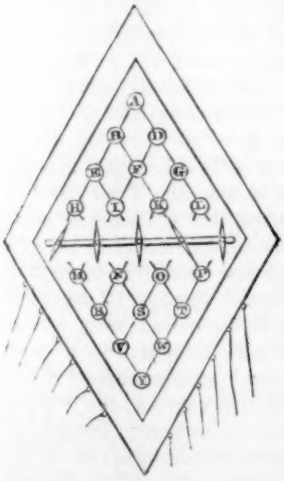
When machine electricity was employed, an electrometer placed on any point of the circuit diverged, and wherever the continuity of the circuit was broken, very bright sparks were visible. With a voltaic battery, or with a magneto-electric machine, water was decomposed, and the needle of a galvanometer deflected in the middle of the circuit. Prof. Wheatstone gave a sketch of the means by which he proposed converting his apparatus into an electrical telegraph, so that, by the aid of a few finger stops, it would instantaneously and distinctly convey communications between the most distant points. The apparatus, as it is at present constructed, is capable of conveying thirty simple signals, which, combined in various manners, will be fully sufficient for the purposes of telegraphic communication.—*Mag. Pop. Sci.*, 1836.

This was Prof. Wheatstone's first telegraph, and having matured his plans, he took out a patent on the 12th of December, 1837, which was sealed on the previous 12th of June, 1837, in conjunction with Mr. W. F. Cook, who had devoted much of his time and attention to the practical application of the Electric Telegraph.

The principle on which this telegraph depended, was that of combining several peculiarly constructed galvanometer needles. It was an application of the famous discovery of Professor Œrsted of the deflecting influence of an electric current upon a magnetic needle, which I have already explained in a previous lecture.

"A signal board was employed, having five vertical galvanometers with double needles, the lower ends of each being slightly the heaviest, so as to ensure at all times a vertical position, except when deflected by the current. From the ends of these needles lines were drawn, both above and below, as in fig. 32, and at the points where these lines intersected, letters and numbers were placed. When an electric current was transmitted so as to deflect at the same time two of the needles, they indicate, by their convergence, one or other of the letters marked on the signal board. Thus, if the first and fifth needles converged above, they pointed to A, if below, to Y; or if the first and fourth converged above, they indicated B, and so on.

Fig. 32.

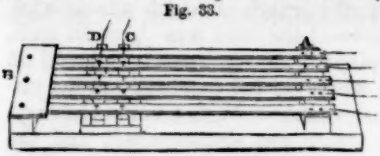


The signal boards were placed at either end of the line of telegraph, having a battery and keys so arranged as to render it easy to deflect at pleasure any of the five galvanometer needles at the distant station: the two sets of galvanometers being connected by six wires, one for each separate needle, and one as a return common to them all. The keys used to connect these wires with the battery were very simple, and at the same time perfectly efficient.

The arrangement consisted of five copper bars, thin enough to be elastic,

fastened to a cross-piece of wood, as at A, fig. 33, and connected with the five wires of the telegraph, whilst their other ends pressed slightly, (but so as to be in good metallic contact,) against a cross-piece of copper, B. The terminal wires of the voltaic battery were attached to two small bars of metal, C D, and in the five longer bars, just where they crossed the battery bars, C D, there was a row of small metal pins, terminated with little ivory knobs. When it was desired to deflect any of the needles in the signal boards, all that was necessary was to press the ivory knobs above those bars, in connexion with the needles to be deflected; the slight pressure, by bending down the bars, insulated them for the time by breaking the contact at B; and the metal pins, by coming in contact with the cross bars C and D, became connected at once with the battery. By this simple arrangement the keys, though always ready for immediate use in sending a signal, were not any obstacle to receiving one, as the bar B, always completed the circuit of all the wires, except at the moment of using the telegraph, and then by the contrivance just described, it was thrown out of connexion. The wires of this first telegraph were insulated in tubes by means of a mixture of cotton and India rubber; then the prepared wires are all passed with certain precaution through iron pipes, which on some parts of the line were buried beneath the ground, and in others raised above it. It was afterwards elevated on wooden posts, as the moisture affected the wires, and destroyed the insulation. The battery employed by them was that of a vessel of copper, with plates of zinc, and acidulated water.

Fig. 33.

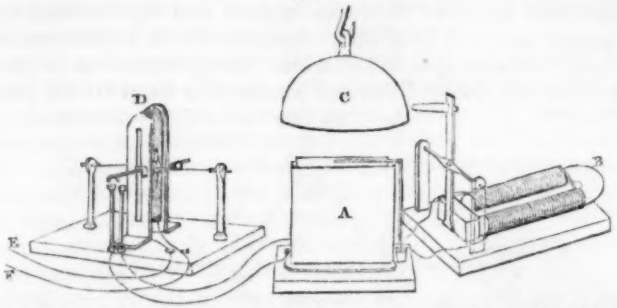



In order that the telegraph could be practically used, it was essential that some simple means should be employed to call the attention of the operator when a message was about to be sent, as the movement of the needles made no sound.

In order to overcome the difficulty presented by the very small amount of power which would be transmitted to a long distance, and which was not sufficient to make an electro-magnet of any power, and thus discharge an alarum, he placed a second battery at the distant station, having wires connected with a powerful electro-magnet attached to an alarum, or arranged so as to strike a bell as soon as the battery was brought into operation. But, as the circuit was broken, the battery, though charged with acid, and therefore ready to act, could not exert its magnetising power on the electro-magnet unless the circuit was completed. The current of electricity from the distant station from whence the intelligence was to be transmitted, though not powerful enough to make an electro-magnet, was abundantly powerful enough to complete the circuit of the second battery, thus waiting to be called into action. This was effected by a small piece of copper wire attached to a cross piece fastened to a delicately suspended vertical galvanometer; when the latter was deflected by even a feeble electric current, the copper wire, by having its ends plunged into two cups of mercury, completed the circuit of the secondary battery, causing the electro-magnet to attract its keeper, and thus let off the alarum to ring the bell. The general

form of the arrangement is represented in Fig 34, which I have taken from a published lecture by Professor E. Solly of London, on the telegraph.

Fig. 34.




E F are the wires conveying the electric current from the distant station; D, the vertical galvanometer deflected by its influence; A, the secondary battery thus brought into action, and B, the electro-magnet which is made to act on the bell, C.

The line of telegraph upon the Great Western Railroad was finished in July, 1839, and had been in operation about seven or eight months. Thirty signals may be conveniently made in a minute. According to Professor Wheatstone, on his examination before a Parliamentary Committee on Railways in 1840, he states, "I have been confining the attention of the Committee to the telegraph now working on the Great Western Railway, but having lately occupied myself in carrying into effect numerous improvements which have suggested themselves to me, I have, conjointly with Wm. Cooke, who has turned his attention greatly to the same subject, obtained a new patent for a telegraphic arrangement, which I think will present very great advantages over that which at present exists. This new apparatus requires only a single pair of wires to effect all which the present one does with five, so that three independent telegraphs may be immediately placed on the line of the Great Western; it presents in the same place all the letters of the alphabet according to any order of succession, and the apparatus is so extremely simple, that any person without any previous acquaintance with it can send a communication and read the answer."

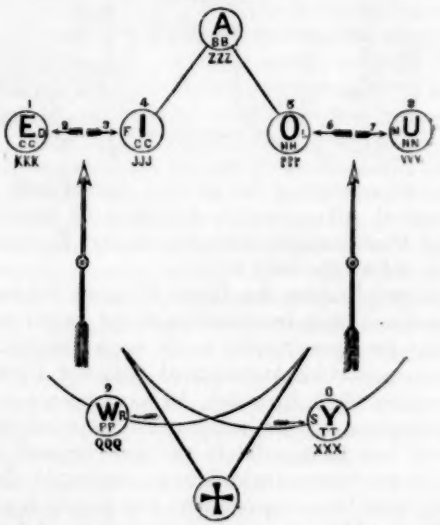
Mr. Saunders, the secretary of the Great Western Railway, states the expenses of constructing the electrical telegraph on the line of that railway to have been from £250 to £300 a mile; whereas, the old form of telegraph in use between London and Portsmouth, independent of the original outlay, costs about £3300 a year; and the lines of telegraphic communication to Plymouth, to Yarmouth, and to Deal, were abandoned in the year 1816, on account of the expenditure for their maintenance.—*Civ. Eng. and Arch. Jour.*

According to the *Tyne Mercury*, the electric telegraph on the South Western Railway, from London to Gosport, cost about £24,000.

Professor Wheatstone specified a second patent for improvements, in the name of Mr. Cook, Oct. 18, 1838, still making use of the deflexion of needles as the signals employed, and using only two wires instead of

five, and a combination of the two elementary instruments. It has two pointers, each worked by its distinct handle, and gave eight single signals, and a sufficient number of compound ones to admit of the twenty-six letters of the alphabet being used. By further conventional signs those letters are made to represent figures; and by blending both systems, a mixed sentence, consisting of passages from a code, spelling and figures, could be telegraphed together. The general form of the dial is shown in Fig. 35. Behind this dial a magnet is fixed on the same axis

Fig. 35.




as the needle, so that both move together. A portion of the conducting wire is coiled many times longitudinally round a frame in which the magnet moves; by this contrivance, the magnet is subjected to the multiplied deflecting force of the voltaic current. The motion of this magnet is limited by fixed stops placed at both sides. The simple signals are given by the movement of the needles, either singly or combined. Thus the left hand needle moved to the left gives E, to the right I: the right hand needle moving to left gives O, and to right gives U. If both converge upward at the same time, their combined indication is A, and if they converge downwards it is +. If the pointers are made to rest parallel to each other in one direction, W is meant, and in the other direction they indicate Y. The consonants most in use are given by two movements of the needle, and those rarely required, such as J Q X Z, by three movements. C and U are generally used for K and V, but not necessarily.

Wheatstone's telegraph cost per mile £100. (*Mech. Mag.*, 1838.) This telegraph, which is the useful and scientific invention of Mr. Cook and Professor Wheatstone, has now been in operation for nearly twelve months; all the wires are enclosed in hollow tubes, not more than about an inch in diameter.—*London Mining Journal for* 1840.

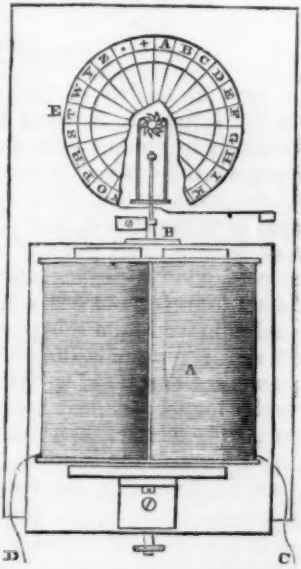
The American patent for Electro-magnetic Telegraph, Charles Wheat-

stone and Wm. Fothergill Cook. Patent for fourteen years from 12th June, 1837, that being the date of the English patent.—*Franklin Inst. Jour., Third Series, Vol.* II. *p.* 120, *August*, 1840.

The American patent was of no benefit to the patentees, as it was never practically employed in the United States, Prof. Morse's instrument being the chief one in use from 1844 to 1846.

The defects in the practical working of his first and second telegraph led Prof. Wheatstone to devise a new form of telegraph, called by him an electro-magnetic telegraph, in January, 1840. The principles employed in this new instrument are well exhibited in Fig. 36 (*Daniells' Elements*). "It consisted essentially of an electro-magnet surrounded with a long and fine wire, A, and a keeper of soft iron, B, prevented from coming in complete contact with poles of the magnet, but so near as to be within reach of the attractive power of the magnet when the latter is under the influence of the current.

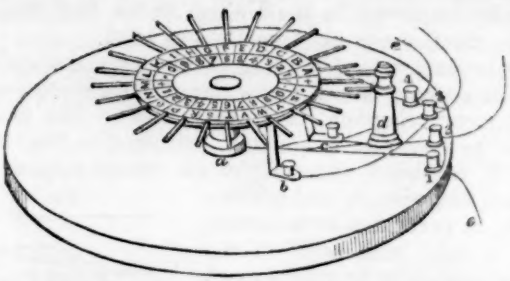
Fig. 36.




The motion of the keeper was made use of in various ways to communicate signals. In Fig. 36 it is represented as acting by a species of clock escapement on a small ratchet wheel, and thus causing the rotation of a light disk of paper or mica, E, on the circumference of which the letters of the alphabet, or other signals, are marked. In the diagram, part of this disk is represented, which resembles very much the signal dial of Mr. Ronalds, and is on the same plan. It is in part cut away to show the position of the ratchet wheel behind. The ratchet wheel resembles one invented by Burgengeiger, a German, to which he had attached an electric clock, as described in the *Morgan Blatter*, of September 23, 1815, and quoted by Mr. Ronalds in his work on electricity, published in 1825. Every time that an electric current is transmitted from a distance by the wires C D, and they may be made to succeed each other with great rapidity, the disk is advanced one tooth of the wheel, and consequently another letter; and when the electric current is interrupted, the keeper being no longer attracted, is drawn up again to its original position by a spring, and the disk advanced another letter. The whole instrument is inclosed in a case, having an aperture in front, which only permits one letter at a time to be seen. In using this telegraph, the instrument is always placed at the commencement with the sign of a cross only visible, which is before the letter A, on the round disk; if it is then wished to indicate the letter H, it is necessary to transmit four separate electric currents, in order to attract the keeper four times, and so cause the disk to move round eight divisions, the letter H will be exhibited. The transmission of the currents is managed by a little

instrument represented in Fig. 37. It consists of a horizontal brass wheel, divided and marked on its upper surface like the disk of the telegraph, with which it perfectly corresponds; the circumference of this wheel is

Fig. 37.

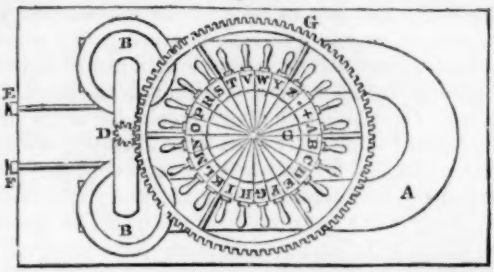



cut away in twelve places, and filled with small pieces of ivory. A metallic spring, *b*, pressing against the circumference of the wheel, is alternately in contact with the metal of the brass wheel and the ivory pieces when the wheel is turned round. When the instrument is not in use, the cross at the commencement of the alphabet is always placed opposite to the stop *d*, as in this position alone the metallic spring, *c*, by pressing on a small piece of metal connected with the stand *a*, cuts off the connexion with the battery, and therefore leaves the telegraph in a fit state to receive signals from the distant station. As soon as the wheel is moved from this position, the battery is brought into connexion, and as it is gradually turned round, the required number of interrupted currents is transmitted to the magnet. In the circumference of the brass wheel a number of iron pins are inserted, one corresponding to each letter, and, therefore, by taking hold of the pin corresponding to the letter we wish to indicate at the distant station, and rapidly turning the wheel till stopped by the cross piece at *d*, we cause the letter disk of the telegraph to revolve the required amount.

The preceding is one of the simplest forms of this telegraph, but the power is applied in many ways; thus, in place of moving the letter disk it may remain stationary, whilst a light hand or index only, is caused to revolve; or in place of an electro-magnet being used, the mere deflexion of a vertical galvanometer may be employed for the same purpose. But as it was found that a telegraph of this kind, though excellent for short distances, was not so suitable for long ones, a modification was adopted, in which the power required was greatly diminished, and the delicacy of the telegraph much increased. In this form a powerful clock movement, acted on by a strong spring, was employed to rotate the disk or index, the attraction of the keeper being only used to regulate the escapement, every current releasing a single tooth, and so allowing the clock movement to advance the disk one letter. He employed a magneto-electric machine instead of the battery, also doing away with the "communicator." Fig. 38 shows a vertical representation of one of the machines used for this purpose, consisting of a permanent magnet, A, an armature of soft iron, B, surrounded with coils of copper wire, and connected with the binding screws, E F. The armature can be

made to revolve by the action of the larger wheel C, on the pinion D, which is thus caused to revolve just so many times by one revolution of the wheel C, as will give rise to the number of currents requisite to turn

Fig. 38.




the telegraph disk once round. The whole of this instrument is inclosed in a box, and the axis of C, which rises through the top of the box, carries a solid brass wheel, G, having handles corresponding to the letters of the alphabet, and signals of the telegraph disk. I extract from the *London Artisan*, *Vol.* iii. *p.* 247, *for Nov.*, 1849, an account of the present condition of this telegraph in England, by Francis Whishaw, Esq.

The construction of the telegraphs, chiefly used in England, may be thus described:—Along the sides of the various railways (for by this system it is wise to have the telegraph wires protected, as far as possible, by a constant supervision) wooden vertical posts of fir timber are ranged at convenient distances. Each post is furnished with an insulator of earthenware, through which the wires are drawn, to prevent their connexion with the wooden posts. The wires are of stout galvanized iron, which are carried from one end of the railway to the other, except in passing through tunnels, or under bridges. In such cases, the insulators are attached to the brickwork; and thus the wires are prevented from being in contact with the brickwork. Each post is furnished with a lightning conductor, and is also capped with a wooden roof, with dripping eaves to throw the rain water from the wires. At each end of the telegraphs, the line wire is connected with an earth battery, consisting of a large plate of zinc or copper, buried in the earth—the object of which is to avoid the necessity of a return wire, which in the first telegraphs in England was made use of. At the various stations, one or more of Cooke and Wheatsone's needle instruments are set up, and which are connected with the line wires and batteries by wires of smaller size, generally covered with silk or cotton, which is easily destroyed by the alterations of weather, and, therefore, is objectionable. Each telegraph on this plan has two wires. The batteries used are of the most simple form, consisting of a trough, divided into any number of cells, according to the power required. Alternate plates of zinc and copper are connected throughout the pile, which dip into sand, saturated with dilute sulphuric acid—the use of the sand being to prevent waste of the acid in the battery, when required to be sent from one station to another ready charged. The signals are given by means of the needles, placed in front of a dial, on which are written or engraved, the letters of the alphabet, being moved either to the right or to the left. Each needle in *front* of the dial is placed on the same axis as a magnetic needle *behind* the dial,

which latter is suspended freely in a space, surrounded by a coil of wire, through which coil, when the current is transmitted either in one direction or the other, the needle is deflected either to the right hand or to the left, as may be desired; so that, by a certain number of movements of each needle, and by the combination of the movements of both, every letter of the alphabet, or any numeral, is given. As many as thirty letters, under ordinary circumstances, are thus transmitted in a minute; but by expert manipulators many more. Although the requisite movements are easily learned, yet it requires many weeks for a telegraphist to work the needle instrument sufficiently well to be entrusted with a communication of any value, whether for railway or commercial purposes; moreover, it is requisite that the two persons communicating with each other should be equally advanced in the required manipulations. Some of the boys employed by the Electric Telegraph Company, have acquired wonderful rapidity in the transmission of messages; while I have known many persons give up the occupation altogether, although having no other employment to resort to. In case of a telegraphist attending the needle instrument being suddenly disabled by illness or otherwise, great inconvenience must be experienced, by reason of no one being at hand to take his place; whereas by other instruments, as that of Siemen's, &c., which can be worked by man, woman, or child, at five minutes' notice, this inconvenience is done away with. The exposure of the wires to atmospheric influence—to storms of snow, as lately experienced on the South Eastern Railway—to the destructive effects of trains running off the way, and to the destruction of the wires by malicious persons (rewards for whose apprehension have frequently been offered), are all fatal objections to the present English system ever becoming universal. Moreover, the expense to railway companies and others is a sad drawback to the further extension of this system in Great Britain and Ireland—for the railways of which alone an extension of at least 2000 miles is still required. The average charge for an electric telegraph, with two wires, as hitherto furnished to the various railway companies in England, may be stated at not less than 150*l.* per mile; added to which an annual sum must be calculated on for keeping it in order, and reinstating, when necessary, the wooden posts, &c. The charge for transmission of communications by the Electric Telegraph Company's telegraphs in England, is at the rate of one penny per mile for the first fifty miles, and one farthing per mile for any distance beyond one hundred miles. The South Eastern Railway Company's charges for telegraphic communications are even much higher than those of the Electric Telegraph Company. Thus twenty words, transmitted eighty-eight miles, is charged the large sum of 11s.; whereas the same length of communication for the distance of 100 miles is only charged 6s. 3d. by the Electric Telegraph Company.

If we judge by the following remarks, some of the English journals appreciate the advantages of this form of telegraph.

"We have heard of things being done 'in less than no time,' and always looked on the phrase as a figure of speech signifying great despatch. The paradox seems, however, to have been actually realized in the invention of Wheatstone's Great Western Telegraph, a message having been sent in the year 1845, and received in the year 1844! It appears that directly after the clock had struck twelve, on the night of the

31st of Dec. last, the superintendent at Paddington, signalled to his brother at Slough, that he wished him a happy New Year; an answer was immediately returned, suggesting that the wish was premature, as the New Year had not yet arrived at Slough. Such, indeed, was the fact, for 'panting' Time was matched against the telegraph, and beaten by half a minute."

On the London and Portsmouth Electric Telegraph, (88 miles,) "Her Majesty's speech, on the opening of Parliament, was transmitted by the telegraph to Portsmouth, and published there almost as soon as in London. The speech contained 3600 letters, and was printed off as it arrived. It occupied about two hours in the transmission, being at the rate of about 300 letters per minute.—*Mech. Mag. Feb.* 1, 1845.

By the following decision of the Judicial Committee of the Privy Council, it will be seen that Messrs. Cook and Wheatstone were refused an extension of their patent, on the ground of their having been "sufficiently remunerated, and that the Electric Telegraph had not been so poor an investment as we have been led to believe by the English Press," as the share-holders have received a bonus of £15 per share, besides the usual dividend of 4 per cent. on £300,000.

"The Electric Telegraph Company sought to obtain the prolongation of letters patent which had been granted to William Fothergill Cooke and Charles Wheatstone on the 12th of June, 1837. The books of the petitioners were made up, it appeared, and balanced to the 31st December, 1850, and the subjoined statement will show the receipts and disbursements of the petitioners since the introduction of the electric telegraph:

| | | | |
|---|---|---|---|
| Receipts from the railway companies for their use of the company's patents, | £122,285 13 2 | | |
| Receipts from maintenance and sundries, | 7,301 13 1 | | |
| | | £129,587 | 6 3 |
| In addition to the foregoing, the company have received gross profits on the erection of telegraphs for railway companies amounting to | | 40,747 | 4 2 |
| | | £170,334 | 10 5 |
| Less charges, including part of the law and parliamentary expenses, | | 34,319 | 6 7 |
| Making the total receipts, | | £136,015 | 3 10 |
| Total amount paid for patents, | | £167,688 | 9 0 |
| Showing that, after crediting the patent account with the above mentioned amount of £40,747 4s. 2d. received for erections, the total payments have exceeded the total receipts by | | 31,673 | 5 2 |
| The Company have in their books charged the capital account of their commercial telegraph with £33,603 10s. 8d. as the estimated value of the patent employed therein. If this nominal charge be added to the amount of actual receipts, as above stated, the patent account will then show an apparent surplus for all patents of | | 1,930 | 5 6 |
| The commercial telegraphs have yielded during the three years which have elapsed since the commencement of their working a total gross return of | £103,444 7 11 | | |
| At charges amounting to | 83,265 6 11 | | |
| Showing a surplus of | | 20,179 | 1 0 |

Which surplus of 20,179*l.* 1s. is the total nett return upon a capital of 104,229*l.* 17s. 8d.—the actual cost, but much more than the present value of the patent—the amount actually expended in the erection of the commercial telegraphs; or upon a capital of 137,833*l.* 8s. 4d. if the patent account is to have the benefit of the above nominal charge of 33,603*l.* 10s. 8d.

The evidence which was adduced in support of the petitioners' case was chiefly directed to show the reasonable charges made by the company, and the accuracy of the accounts.

Their Lordships decided that, as the patentees themselves had been sufficiently rewarded, the company—who derived their right from them—had no *locus standi*, and therefore refused the application.

To be Continued.

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For the Journal of the Franklin Institute.

*Description of Improvements in Seeding Machines. Patented by* S. & M. Pennock, *Kennett Square, Pennsylvania, July 8th,* 1851.*

Fig. 1 represents the Pennock Drill, as last improved.

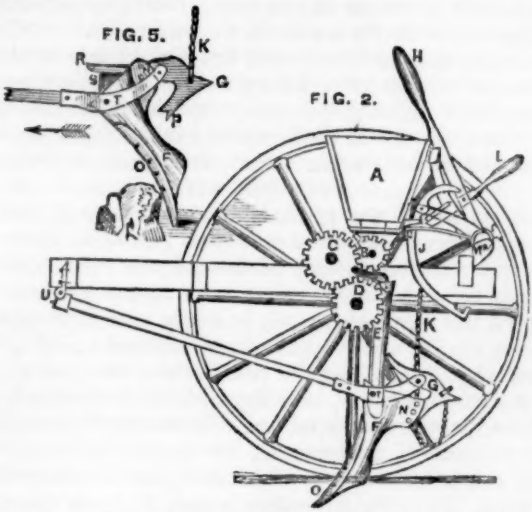
Fig. 2, is a sectional view of the same. Figures 3 and 4 represent the cylinders for distributing the grain. Figures 5 and 8 represent the improved depositing tube shown in fig. 2. Figures 6 and 7 are modifications of the same. The same letters on different figures represent the

Fig. 1.

same parts. In fig. 2, A is the seed hopper; B, cog-wheel upon the end of the seeding cylinder; C, an intermediate wheel, by which motion is imparted to the seeding cylinder, B, from the cog-wheel D, which is fixed on the axle of the machine. E, a leathern tube to conduct the

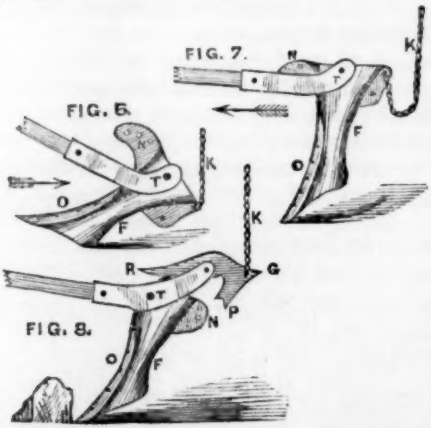
* See page 101.

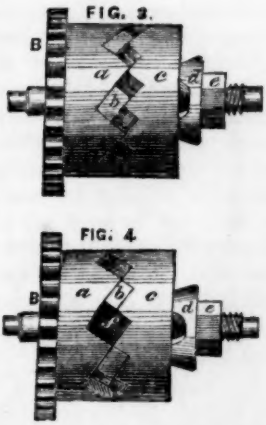
grain from the cylinder B, into the iron depositing tube, F; G, a self-adjusting lever; H, a handle by which the entire machine is thrown out of gear; L, a lever by which the entire machine is thrown into gear; J, the handle for starting and stopping each row separately; *a* and *c* are sections of the cylinder, or cylinder caps, the proper thickness for the depth




of the seed receptacles; *b* is an oblique projection cast upon the periphery of a plain ring, forming the bottom of the seed receptacles.

The projection, *b*, is fixed to its place against either the *a* or *b* section of the cylinder, by a screw entering it through the end of the cylinder cap, against which it is fixed.




To adapt the cylinder to seeding wheat, rye, or smaller seeds, the projections *b*, are to be confined to the cap, *a*, as in fig. 3, forming 12 medium sized seed receptacles. For planting corn, oats, or other large

grain, the projections, *b*, are attached to the cap, *c*, by changing the screw to that end of the cylinder, thus forming but six large seed receptacles, as in fig. 4.

The seed receptacles may be varied in size at pleasure, by simply loosing the screw nut, *e*, from against the washer, *d*, which is of such a peculiar form as to throw the line of bearing at right angles to the contiguous obliquities of the teeth upon the caps *a* and *c*.

The depositing tubes are suspended in a forked bar by side bearings at T. N, are three holes in which a wooden pin is inserted to secure the depositing tube in its proper position, said pin being intended to break and allow the point of the depositing tube to turn backward when it comes in contact with a rock, root, &c., whilst the machine is in motion.

The depth to which the grain is deposited is regulated simply by changing the said pin from one of the holes, N, to the other. In figures 6 and 7, the pin rests on the top of the drag-bar, and must invariably give way when the point of the tube comes against a fixed obstruction; while in figs. 5 and 8, the lever, G, is made to relieve the pin (upon which it bears at P), when approaching rocks, &c., by tightening the chain, K, as in fig. 8, allowing the point of the tube to turn backwards and pass over the obstruction, as in fig. 5, without damaging said point. When the tube has passed the rock, it falls forward of its own weight, drawing the point R, of the lever, G, down upon the cam, S, holding it in its proper place, as in fig. 5, until the chain, K, is loosed, when the lever, G, again falls with its notched end, P, upon the wooden pin, and the machine moves on without detention. Another great advantage possessed by Pennock's patent depositing tubes over others, is the impossibility of clogging or damaging them when the horses set, or run backward with them in the ground, the arrangement being such as to allow them to turn forward, as in fig. 6. Each depositing tube is provided with a point, steel plate, O, which is not only reversible, but either of its points may be extended several times as they become worn.

These plates alone are a saving to the farmer of from $12 to $15; so each sell. The hinge joints W and T, are both of such peculiar construction as to admit of removing the drag-bar from the frame of the machine, and the depositing tube from the drag-bar, without the use of any kind of mechanical improvement, or without loosing a screw.

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### *Opinion of* Justice Cresswell, *in the Case of The Electric Telegraph Company vs. Brett and Little.**

Judgment delivered by Mr. Justice Cresswell as follows:—This was an action brought by the plaintiffs against the defendants for the infringement of a patent. The patent was granted in 1837 to Messrs. Cooke and Wheatstone, for "improvements in giving signals and sounding alarms in distant places, by means of electric currents transmitted through metallic circuits," and was afterwards assigned to the plaintiffs. The action was tried at the sittings after Hilary term, 1850, before Lord Chief Justice Wilde, and a verdict was then found for the plaintiffs; and

* From the London Railway Magazine, No. 621.

in answer to certain questions put to the jury by the learned judge, certain special matters were found, on which the defendants had leave to move to enter the verdict for the defendants. A rule *nisi* was accordingly obtained, to which cause was shown; and in the argument the chief question raised was, what was the proper verdict to be entered in respect of the special matters found by the jury in answer to the questions of the Lord Chief Justice. To the third question, which was material, the jury found that the magnetic ring and indicator of the defendants was a different instrument from the needle claimed in the specification of the plaintiff's patent; and they also found, in answer to the fourth question, that "the sending of signals to the intermediate stations was new to the plaintiffs," by which expression was to be understood that it was a new invention of the patentees. The jury also found, in answer to the fifth question, "that the angular motions of the needles in vertical planes or horizontal axles, conjointly with the stops, was new to the plaintiffs," meaning that it was a new invention of the patentees. In answer to the sixth question, they found, "that as a whole the defendants' system of communicating with one wire and two needles was not the same as the plaintiffs'." It was insisted by the plaintiffs on showing cause, that on these findings they were entitled to retain the verdict in respect to the answers on the fourth and fifth questions. It appeared that the defendants, by means of duplicate coils and apparatus at the intermediate stations, had sent signals to all the intermediate stations, as well as between the terminal stations, and that they used an instrument moving in a vertical plane, called "a magnetic ring and indicator," producing nearly the same result as the needle described in the plaintiffs' specification. The jury, however, having found that the magnetic ring and indicator was a different instrument to the needle used by the plaintiffs, the defendants insisted that their use of it was no infringement of the plaintiffs' patent. The objection, however, mainly relied upon, was, that the plaintiffs' specification protected only the patentees' improvements as applied to metallic circuits, and that if the electric current was transmitted by improved machinery, not by a circuit wholly metallic, the improvements might be used without an infringement of the patent. The defendants using the earth to complete the circuit of the electric current, did not use a metallic circuit, and, therefore, they denied that the use of the plaintiffs' other improvements was an infringement of the patent. This was a grave objection, but the Court was of opinion, after full consideration, that it ought not to prevail. At the time of the grant of the patent the transmission of electric currents through metallic circuits was known, and also that the power of the current might be increased by coils in the wire. The discovery that the earth would complete the circuit of the current between the two ends of the wire struck into the ground, was made after the grant of the patent. The patentees did not, therefore, claim the invention of metallic circuits, but only improvements in the method of using electric currents—the currents being transmitted by a means open to the public. The circuit used by the defendants, so far as it operated in giving signals, and in all the parts to which the plaintiffs' improvements applied, was metallic: and it was not a necessary condition that the residue of the circuit should be metallic. The

specification which claimed and described the invention was to be more strictly construed than the title of the patent, and the Court thought that the specification sufficiently comprehended all circuits that were metallic, as far as it was material to the improvements claimed that they should be so. And with regard to the use of the term, "metallic currents," in the title of the patent, the Court thought the title gave sufficient notice to any person acquainted with the discovery, or who had invented similar improvements to the patentees', to put him on his guard as to the nature of the plaintiffs' patent, and lead him to enquire how far any contemplated improvements would infringe it. The Court thought it but reasonable to hold that a claim for a patent for improvements in the mode of doing something by a known process, was sufficient to entitle the claimant to a patent for his improvements, when applied either to the process as known at the time of the claim, or to the same process altered and improved by subsequent discoveries. The next objection was, that the plaintiffs' patent was for a system of giving signals by means of several wires and converging needles pointed to certain letters, whereas the defendants used one wire, and made signals by counting the deflexions of the needle, which was found by the jury to be a different system. The Court thought this objection founded on a wrong discussion of the specification, which showed the patent to be not for a system of giving signals, but for certain distinct and specified improvements comprehending those now in question. The Court, therefore, thought the objections ought not to prevail to the grounds on which the plaintiffs claimed the verdict in respect to vertical needles and of the use of duplicates at intermediate stations. It might be doubtful whether the plaintiffs could claim the verdict with regard to the use of vertical needles by the defendants, considering the finding of the jury; but the Court thought that the use of duplicate apparatus at the intermediate stations, which the jury found to be a new invention, and which undoubtedly the defendants had used, entitled the plaintiffs in this respect to keep their verdict. If, however, the defendants' discovery enabled intermediate stations to send as well as receive signals, that was a very important improvement, for which the inventor might probably be entitled to a patent, though he might not be entitled to use it except by the license of the patentee of the less perfect invention on which the latter invention was grounded. For these reasons the Court thought the plaintiffs entitled to retain their verdict, and the rule must be discharged.—Rule discharged.

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*Opinion of Judge Kane, delivered before the United States District Court, Pennsylvania, in the Case of Detmold vs. Reeves, on a Motion for an Injunction, September*, 1851.

This is an application for a special injunction to restrain the defendants from further violating the complainant's patent.

The complainant, Mr. Detmold, is the assignee, and as such, the patentee in this country of an invention made by Mr. Faber du Faur, and patented by him in 1840 and 1841, in Bavaria and Wurtemburg. The American patent was issued in 1842, but it was amended and re-issued

in 1845. It is for "a new and useful invention for generating and applying heat;" and its immediate subject is a new mode of collecting, conducting, and using the combustible gases that ordinarily escape from the tunnel head of the blast furnace. The defendants are extensively engaged in the manufacture of iron, and it is charged that they are availing themselves of a part of the patented invention.

The interests which are involved in the controversy are very large, and may be seriously affected by the action of the Court on the present motion. The argument, therefore, has had the widest range—embracing the originality of the patented invention, its practically useful character, its identity in principle with the apparatus employed by the defendants, the right of the inventor and his assignee to protection under the Patent Laws, the regularity of the proceedings of re-issue, and their legal effect, as well as the policy of postponing the summary relief, which it is the province of equity to administer, until after an adjudication of the merits by a Court of Law. But of these questions, which were argued by the learned counsel on both sides with characteristic ability, there is only one, after all, which, on a careful review of the whole ground, I deem it necessary to decide.

The claim of the complainant, as it has been expounded by his counsel in the present case, is for "a new method of economizing fuel, by using the waste combustible gases of the upper portion of the blast furnace, by drawing them off below the upper level of the charge, and conducting them through convenient passages to other fire-places or structures, there to be burned as fuel." It does not assert an exclusive right to the use of gases from the tunnel head, nor to the employment of pipes or tubes for conducting gases; and very properly, for both of these were long ago familiar to the arts: its essential characteristic is, that the gases are to be withdrawn "below the upper level of the charge."

Can such a claim be legitimately deduced from the terms of the patent before me? This is the controlling question of the cause.

The descriptive language of the specification does not designate, as the place for taking off the gases, a point "below the level of the charges;" an expression that would apply equally well to any and every such point; but one, "at or near that point of the furnace, where the lime stone employed as a flux is completely calcined, and the reduction or deoxydation has not yet commenced;" and this point, it adds, "will generally be at about one-third of the height of the whole furnace below the tunnel head, or two-thirds above the bottom stone."

It is true, that the formal claim at the close of the instrument speaks of drawing off the gases at "one or more points below the top of the fuel;" and if the expressions *fuel* and *charges* can be regarded as convertible, this would certainly countenance the exposition of the complainant's counsel. But it does not stand alone; and it cannot be interpreted fairly without giving effect to the words that follow it: "substantially as set forth in the above specification." There is then an important qualification of the broad language of the claim;—one that limits and defines it by a reference to the description that has gone before;—and when the two parts are taken together, as they must be, they do not import the withdrawal of the gases from below the top of the charges generally, at any

and all points whatsoever; but specially from at or near that point below the top of them, at which the flux has been calcined, and the deoxydation is about to begin.

The explanatory or practical reference, which is added in the specification, to a point one-third below the top of the furnace, makes this even more plain. For the indication of a point, ascertainable by simple measurement, as the one that will in most cases conform the structural arrangement to the rule deduced from scientific principle, is almost a declaration in terms, that the patentee had in view a *particular* point, and did not mean to apply his claim to all points below the charges alike.

So far, then, as the motion for an injunction asserts as its basis, that the defendants are using a device which has been specifically described and claimed in the patent, it cannot be sustained; since it is conceded that the defendants do not take out the gases "at or near the point at which the calcination is perfected, while the deoxydation has not yet begun;" nor at or "about one-third of the height of the tunnel," measured from the top. But the question still remains, whether the defendants are not violating the patent substantially; deriving from it information essentially connected with its subject matter; and only so far varying their structure in form and proportion as to elude its terms.

There is no doubt, that he who has discovered some new element or property of matter, may secure to himself the ownership of his discovery, so soon as he has been able to illustrate it practically, and to demonstrate its value. His patent, in such a case, will be commensurate with the principle which it announces to the world, and may be as broad as the mental conception itself. But then, the mental conception must have been susceptible of embodiment, and must have been in fact embodied in some mechanical device or some process of art. The abstract must have been resolved into the concrete. The patent must be for a thing, not for an idea merely.

This limitation, it may be said, denies to some of the more important products of mind, what it concedes to others of lower grade. But it is not the less true on that account. Men may be enriched or made happy by physical as well as by moral or political truths, which, nevertheless, go without reward for their authors. He who devised the art of multiplication could not restrain others from using it after him, without paying him for a license: The miner who first found out that the deeper veins were the richer in metal, could not compel his neighbor to continue digging near the surface.

The more comprehensive truths of all philosophy, whatever specific name we give to it, cannot be specially appropriated by any one. They are almost elements of our being. We have not reasoned them out perhaps, and may even be unconscious of their action; yet they are about us, and within us, entering into and influencing our habitual thoughts, and pursuits, and modes of life, contributing to our safety and happiness; and they belong to us as effectively as any of the gifts of Heaven. If we could reach the laws of nature, they would be, like water and the air, the common property of mankind; and those theories of the learned, which we dignify with this title, partake, just so far as they are true, of the same universally diffused ownership. It is their application to prac-

tical use, which brings them within the domain of individuals; and it is the novelty of such an application, that constitutes it the proper subject of a patent.

But the contract of the public is not with him who has discovered, but him who also makes his discovery usefully known. If he has discovered much, and discloses little—if there has been revealed to him one of the *arcana* of nature, and he communicates to the world only some one or more of its derivative and secondary truths, he patents no more than he has proclaimed. He will not be allowed afterwards, when the extent of his right shall be the subject of controversy, either by expanding into a general expression what was limited before in a particular form, or by tracing out for us the line that leads back from consequences to their remoter cause, to initiate us inferentially into the radical mystery of his invention, and then argue that he had described it by implication from the first, and so claimed ownership of it in his patent.

If, as it has been contended with great apparent force, M. Faber du Faur was really the discoverer of the true theory of the Blast Furnace, so as to determine from it the point at which the carbonic oxide, having performed its chemical function, might be withdrawn without sensible injury; if he knew that the gases, when taken from openings nearer the boshes, were capable of more intense combustion, but that their withdrawal so low down impoverished the action of the furnace, and that when used at the tunnel head, after they had performed successively the offices of deoxydating the mineral, calcining the flux, and vaporizing the water of the charges, they were less available as fuel in consequence of their increased impurity;—and, if knowing this, he had taught the iron master how to choose the best place for withdrawing the gases, having reference to the dimensions of his furnace, and the different sorts of fuel and mineral and flux employed in it, and with reference also, perhaps, to the purpose for which the flame of the gases was to be applied after they had been withdrawn;—no one can doubt that he would have conferred a signal benefit upon the arts of the world. And if he had, besides this, devised some form of structure, some material arrangement, by which his discovery might be applied to use, I would be most reluctant to say, that his patent, properly drawn out, should be limited to the mere mechanical illustration, and could not cover effectually the whole ground of his discovery.

But M. Faber du Faur and his assignee, Mr. Detmold, have not done this. They have announced no new principle of science, no natural law. They indicate to us the place at which the gases should be taken out, first, by reference to a scientific problem, which they leave unsolved, and next, by a proximate reference to mechanical measurement. There is not, so far as my inquiries have gone, anything less definitely settled among the skilful in these matters, than the point at which the calcination of the flux is completed, and the deoxydation of the mineral begins. Some deny altogether that any one point can ever satisfy both of the conditions, for they assert that the reduction always begins before the calcination is perfected; and all concur that the point, if there be one, must vary with the form and proportions of the furnace, and the chemical elements of the ore, the flux, and the fuel, and that it is, moreover, affected sensibly by atmospheric changes.

This indication is too vague therefore, and, under the varying circumstances to which it must be applied in practice, too erroneous also, to vindicate for the patented discovery the broader or generic character.

The other indication, which refers to a proportionate distance from the tunnel head, "one-third, or thereabouts," is merely specific.

The interpretation, therefore, which I am constrained to give to the part of Mr. Detmold's patent, which is involved in the present discussion, limits his claim to the formal arrangement, without an assertion of right to any dominant principle. The defendants have perhaps derived instruction from his descriptions, and may even to some extent have modelled their furnace, with its appendages, upon a theory which they suggested. But it does not appear to me that they are infringing or have infringed his patent.

The motion for injunction must be dismissed.

Messrs. Harding, Campbell, Hazlehurst, and Cadwalader, for the motion. Messrs. Sheppard, Gerhard, Meredith, Williams, and Mallery, contra.

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For the Journal of the Franklin Institute.

*Remarks on the Opinion of Judge Kane, in the Case of Detmold vs. Reeves.*

*To the Committee of Publication.*

We furnish for publication in your Journal, the foregoing opinion of Judge Kane, of the Circuit Court of the United States, for the Eastern District of Pennsylvania, in the case of C. E. Detmold *vs.* D. Reeves, involving the validity of a patent issued to Mr. Detmold, as assignee of Faber du Faur, of the kingdom of Wurtemburgh. This patent claims an exclusive interest in a mode for using the waste gases of blast and other furnaces, and if its validity had been established, it involved heavy damages against the owners of blast furnaces; unusual latitude of discussion and testimony were therefore allowed to the respective counsel and parties, even in this merely preliminary stage of the case. Several weeks were occupied in the hearing. The whole merits were fully spread before the Court. The printed evidence occupies a large space, and consists of the testimony of persons selected by both parties, as most likely, by their science or practical knowledge, to cast light upon the points brought in question. Perhaps few cases are better fitted to exemplify the wide field of knowledge, and the varied investigations which Judges and members of the Bar are compelled in the course of their duties to traverse and enter, than the present. We can easily conceive that the thorough comprehension of a case like this, must have been a matter of exceeding difficulty, to even the most disciplined and the best furnished minds of the profession. We are gratified to say that the case was presented to the Court with signal ability on both sides; with an ability and industry which fairly exhausted the whole case. Having a pretty full knowledge of its main features, and believing that there were objections fatal to the claim of the complainant in matter of form, as well as upon the merits; we supposed the case would go off upon some point of informality. Defendant's counsel had urged, certainly to our satisfaction, three or four fatal obstacles to complainant's recovery. We confess to some surprise, on looking at the decision, to find it furnished other ob-

jections equally fatal to the claims of the patent—to find its validity denied upon grounds which cover every vestige of presumption in its favor. It is seldom we meet an instance of more keen perception, sounder judicial discrimination, or more successful pursuit of truth in a difficult case, than is displayed by this decision. Not only were there complicated questions of science involved, but these were complicated by the variable working of the interior of the blast furnace, and further mixed up with the new and still incomplete art of employing the waste gases, as a fuel to generate steam.

It is very evident that the Judge has succeeded in mastering the mysteries thus encountered, so far, at least, as they have been explained by men of experience or men of science; the contributions of very many of whom combined, go to make up the sum of knowledge on which this case is decided. We say this because we mean to follow it by insisting that this decision *demonstrates* the invalidity of the patent in question. It does not merely decide that the claim of the patent cannot be sustained; it *shews* that it is good for nothing. No one who will take the trouble to make a sufficient acquaintance with the facts to understand the opinion, can lose a moment in perceiving that the claim of Mr. Detmold, as it now stands, is without any legal support. It may not be without use to subjoin a short statement, in reference to the patent upon which the claim of the complainant in this case was preferred.

On the 16th April, 1842, Mr. Detmold took out a patent in the United States, as assignee of Faber du Faur, to whom two patents for the same invention had issued in Europe; one in Bavaria, and one in Wurtemburgh. Upon the allegation of a defective specification in the patent of April, 1842, it was cancelled upon the petition of Mr. Detmold, to whom an amended patent was issued, 8th Jan., 1845. The petition sets out no other defect, than that the patent should have run from the 12th of May, 1840, the date of the Bavarian patent, instead of the 12th of Nov., 1841, the date of the Wurtemburgh patent. It was urged by the counsel of defendant, upon grounds which are believed to be impregnable, that the re-issued patent of January, 1845, is void for informality, in more than one respect. Judge Kane, overlooking these objections, considers the patent of January, 1845, upon its merits. It is material, however, to a full comprehension of the case, that the reader be made acquainted with the terms of the patent of April, 1842, on which the re-issue was made, as well as those of the re-issue itself. The terms employed in the first, are those of Faber du Faur, the inventor: those used in the second belong to Mr. Detmold, the assignee. The patent of April, 1842, "*claims*" as the invention of Faber du Faur; 1. "*The employing carbonic oxide gas "as a fuel in combination with highly heated atmospheric air, &c.* 2, Certain "*described modes of collecting and drawing the carbonic oxide gas in a "pure and uninflamed state, from blast and other furnaces.*" "3, *The "application of the blow pipe to furnaces, substantially in the manner above "described, by which jets of highly heated atmospheric air are forced among "the gases in the furnaces, thus enabling the oxygen of the atmospheric "air to become thoroughly incorporated with the inflammable gas, and "thereby effecting its complete combustion, and, consequently, a most intense "temperature.*"

"The inventor disclaims the *discovery of carbonic oxide gas, or of its*

*combustibility;* also, the construction of blast furnaces, &c., *except so far as they embrace the apparatus for collecting and conveying the gas, and the combination of the gas chamber, air chamber, blow pipes, and long fire-bridge.*" The exceptions thus made, are fully described in the drawings which accompany this patent, and exhibit the "*new method of using carbonic oxide as a fuel, so as to have it in a pure, uninflamed state,*" and his "*new method of employing the blow pipe in furnaces, by which continuous jets of highly heated atmospheric air* are mixed *with the gases.*"

The terms thus employed by the inventor himself, in setting forth his claims, are so clear, that there is no pretence of any infringement, now, or heretofore, in Pennsylvania.

This patent, although not infringed, was subject to a claim of priority, in favor of M. Sire, of France; but we think the claim of Sire less likely to have defeated the patent of April 1842, than the re-issue of January, 1845, to which it is fatal. The claims of the re-issued patent, are in the following terms:

"*First.* I claim the collecting and drawing off the combustible gases, chiefly consisting of *carbonic oxide gas*, from blast and other furnaces, at *one or more points below the top of the fuel in said furnace*, substantially as set forth in the above specification; for the purpose of employing said gases, instead of other fuel, for the heating of all kinds of furnaces used in the various processes of manufacturing and working iron and other metals, and for the heating of *steam boilers* or any other structure requiring a high temperature.

"*Second.* I claim the above-described mode, or any other substantially the same, of generating combustible gases from any kind of fuel in separate furnaces or chambers, and conducting the same to other furnaces or structures, that are to be heated by the combustion of said gases.

"*Third.* I claim the above described mode, or any other substantially the same, of forcing through a system of blow pipes, or in any other convenient manner, heated air in numerous small streams and under a pressure greater than that of the atmosphere, into the said combustible gases in the furnaces or structures, where the same are to be used for the purpose of producing, by the rapid and intimate mixture of the heated air with the combustible gases, their immediate and complete combustion."

The intelligent reader will have no difficulty in determining that these patents are for essentially different things; their apparent connexion lies in the description and drawings, which are the same in both. If inclined to look closely, he will find that, whilst the description and drawings correspond to the invention of Faber du Faur, they do not at all fit the invention and claims of the re-issued patent. There is ground for strong presumption, that the words of the invention and claim were altered to include the actual processes of the American iron masters, and that the same precaution was not applied to the drawings. If the claim of the re-issue is to be explained by its drawings, it is substantially the same as the patent of April, 1842, of which it took the place, and which it is admitted has not been infringed; if the re-issue is to be tested on its merits as an invention, its fate must be inevitably that which Judge Kane's opinion has assigned it—utter invalidity.

It must be matter of surprise, and should be matter of inquiry, how such an amendment as that made in the re-issue, was ever permitted at the

Patent Office. It is clearly not such as is contemplated by the act of Congress under which it was made.*

We mean not in regard to the objections which lie to the formalities of the proceeding, but in reference to the extent and import of the changes made in the terms of the patent. It can only be explained on its face, by supposing that the Officers of the Patent Office, held that the drawings would control the very loose phraseology introduced for the purpose of covering the American processes; they could not have supposed that the amendments were expressly framed to make infringements *ex post facto*, and yet that would have been the effect, if the re-issue has been ruled to be valid. We are far from wishing to deprive Faber du Faur of the credit due to him for his share in the discoveries which led to the profitable employment of the waste gases of the blast furnace. We freely accord to him the praise of having preceded his French rivals in practical processes, if, as they claim, they preceded him in the invention. It would be hard to discover at this day, to which we are most indebted, the French or the German school; our impression is, that the first knowledge of this subject came to us upon the pages of the "*Annales des Mines*," and that our attention was first turned to the French attempts. Still, if the assignee of Faber du Faur had adhered to his real invention as described in the patent of April, 1842, and if that had been violated here, it might have been very difficult to have established French precedency to the "*new method*" claimed in that patent.

We beg leave further to say that, while we are not behind any in our desire to protect the interests and reward the genius of inventors, we must insist that the interests of the public are not to be forgotten. The case before us is one in point. Upon the strength of Judge Kane's decision, we may now assume the patent of Jan., 1845, under which Mr. Detmold claims, to be invalid, yet such is the difficulty of defence, and so great the expense of resistance, the complainant has already levied a very large sum from those who preferred payment, to the trouble and cost of litigation; and if all had been equally yielding, he could have exacted several hundred thousand dollars from the manufacturers of iron, not upon any just consideration, but upon their aversion to litigation. No one who does not know, could form a conception of the trouble or expense incurred in thus defeating Mr. Detmold's application for an injunction, merely the first step in his case. And it should be well considered what this application for an injunction implies,—that the blast furnaces of Pennsylvania must cease their operations, that thousands of men, women, and children, must wait for their bread, that hundreds of

*"*Act July* 4, 1836.—Section 13.—And be it further enacted, That whenever any patent which has heretofore been granted, shall be inoperative or invalid, by reason of a defective or insufficient description or specification, or by reason of the patentee claiming in his specification, as his own invention, more than he had, or shall have, a right to claim as new, if the error has, or shall have arisen by inadvertency, accident, or mistake, and without any fraudulent or deceptive intention, it shall be lawful for the Commissioner, upon the surrender to him, of such patent, and the payment of the further duty of fifteen dollars, to cause a new patent to be issued to the said inventor, for the same invention, for the residue of the period then unexpired, for which the original patent was granted, in accordance with the patentee's corrected description and specification."

thousands of dollars of capital must be sunk, and untold damage to property be incurred, whilst the courts are determining the validity of a patent, which may at last turn out to be wholly worthless.

THE FURNACES.

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*The Royal Prussian War Steamers Nix and Salamander.**

The war steamers "Nix" and "Salamander," are two sister vessels, which have been built and equipped for the Prussian Government by Messrs. Robinsons and Russell, the eminent engineers of Millwall. These vessels are armed on a peculiar system, recently patented by John Scott Russell, Esq., F. R. S., one of the members of the firm, and offering considerable advantages over the ordinary method of arming steamers as adopted in our own and foreign navies.

It is acknowledged on all hands, that the introduction of steamers has completely nullified all our experience in naval warfare, but it is not so uniformly agreed as it should be, what is the best method of fulfilling those conditions which are necessary to future success. For a most interesting discussion of the subject, we must refer our readers to the Report of the Committee to enquire into the Practicability of Arming the Mercantile Steam Marine of this country, published in our volume for 1849. Although differing on other subjects, all admit the inadequacy of the ordinary armament of steamers. Lieut. Julius Roberts, a marine artillery officer, "would not call a steamer armed, if only with *broadside* guns and paddle-wheels—wants heavy pivot guns." J. R. Engledue, Esq., R. N., (Superintendant, P. and O. Co.) says, "since the late war the armament of every nation has advanced, and nothing but a heavy gun will do now." Capt. W. H. Henderson, R. N.: "*Large* steamers would be available against line-of-battle ships, because the latter would be taken on her weak points by the *larger guns* of the steamer, which would keep at a distance." Capt. H. D. Chads, R. N.: "We attach too much importance to speed, and forget the guns."—"An efficient armament both at the broadside and extremities are necessary."

It thus appears that a steamer must have heavy guns, and enough of them, to enable her to go into action with any chance of success. Captain Henderson lays stress upon the size of the steamer, assuming that only our large steamers can carry heavy guns. The cause of this disproportion of weight of metal to tonnage is apparent. The danger of exposing the broadside of the steamer, has caused our vessels to be armed only at the extremities, with one heavy gun at bow and stern, where, if speed is to be obtained, the lines must be fine; thus affording an inadequate support for the weight to be carried. The effect of this weight in a heavy sea is distressing to the vessel, and materially injures her seaworthy properties.

These difficulties are at once obviated by Mr. Russell's arrangement. The sponsons are enlarged, and the side of the vessel made immensely strong at that part by the iron arch shown to the left hand in the section at E, F. On these sponsons are placed the four 68-pounder guns, 1, 2, 3, and 4; the weight being thus removed from the extremities to the

* From the London Artizan for June, 1851.

centre, the strongest part of the vessel, where the breadth of beam is best able to carry them. When gun 2 is trained as gun 4, their fire can be made to converge to any point from 100 yards distance, and the vessel can thus engage end-on, firing *two* guns, and offering her bow or stern only as a target for the enemy. If engaged with two vessels at once, she can as readily use all four guns, and simultaneously. When not engaged, each gun is housed in the position shown by gun 1, the weight being thus brought to the centre of the vessel, and equally distributed. A pair of 32 pounders afford additional means of attack or defence when required by the nature of the service.

The vessels themselves are constructed both ends alike, and with a rudder at each end, so that they can go ahead in either direction without turning round. The rudders are protected by being housed, as it were, in the cutwater, and are entirely below the water-line. They are held in position when either is out of use, by a pin dropping into the rudder, and lifted by means of a screw and handle. The light draft of these boats, about 6 feet 9 inches, when fully equipped, adapts them to river service, and enables them to take refuge in shallow water when pressed by a superior force, which, if not armed with guns of equal weight, has no alternative but to decline the combat.

We had the pleasure of witnessing a most satisfactory trial of the *Nix*, on the 29th of March, when the average speed at the measured mile was 11·684 knots per hour, the engines making 32 to 34 revolutions per minute. The heavy guns were fired, and showed the accuracy of the gunnery by the shot crossing each other at 300 to 500 yards distance.

The following are the leading dimensions of the hulls, engines, and boilers:—length, extreme, 186 feet; beam, 26 feet; depth of hold, 11 feet 6 inches; 560 tons burden. A pair of oscillating engines of 160 horses nominal power; indicated ditto, 754; cylinders, 48 inches diameter × 4 feet 5 inches stroke; inside diameter of boiler tubes, $2\frac{1}{2}$ inches; consumption of fuel, $3\frac{1}{4}$ lbs. per indicated horse power per hour; capacity of bunkers, 100 tons. Weight of machinery, coal bunkers, boilers, &c., 80 tons. Frames of vessel, $3\frac{1}{2} \times 3 \times \frac{3}{8}$ inches; thickness of plates, $\frac{1}{2}$ and $\frac{3}{8}$ inch.

The hull is divided into 13 water tight compartments by 12 bulk-heads. The boilers are entirely separated from the engine-room, and the bulk-heads are fitted with doors, which allow a passage from the engine-room to the stokehole, and can be set up by screws, to render them tight in case of the boiler being struck by shot. To diminish the risk of this, as far as possible, they are well defended by the coals, and the hull is lined with teak, 8 inches thick.

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## *On Furnace Bars.**

In the sitting of the 18th of July, M. Auguste Perdonnet in the chair, M. Polonceau gave an account of a paper of M. Arson, on a furnace bar of a new shape, made of two common bars melted together so as to form only one piece, by contact at their ends as well as in the middle. The hollow between the bars is one-third inch, the thickness of the bars themselves being one-half inch; but the hollow may be brought down

* From the London Architect for September, 1851.

to one-quarter inch, for the same width of bar. He observed, that experience has shown the advantage of making the bars thin, and their intervals narrow, which allows the air to be spread more uniformly among the burning heap, and stops the small coal from falling through the bars. These bars have the evil of getting out of shape, but M. Arson's plan overcomes this. The only hindrance to the new plan of bar is in the moulding, but M. Arson has been successful.

It was observed, that on the Northern Railway they had given up cast iron bars for the fixed engines in the workshops, because they get out of shape and become very rough. These have been replaced by wrought iron bars, costing about 2*d.* a pound, being double that of cast iron, but lasting twice as long; and when of no use for bars, saleable as old iron.

One of the members supported this observation, but said the cost of the bar is 1¾*d.* a pound. The maker is furnished with ends of rails reckoned at ¾*d.* a pound; and he gives weight for weight of finished bars at 1*d.* per pound for workmanship. When he is supplied with old bars used up, he requires 125lbs. of old iron, for 100lbs. of new furnace bars, which brings the price up to 2*d.* a pound. It is found worth while to work up the old iron in this way.

It was remarked, that coal burns wrought iron more than cast, but that it was not so with coke.

A member recommended the employment of bars of which the ends are beveled on the upper edge, which prevents misshaping by unequal heating. These bars have been used with advantage in several works at Douay, being on a similar plan to locomotive bars.

Another member said he had tried the double bar of M. Arson. These bars were half an inch thick with half inch openings, and they were used in a furnace worked with coke. The combustion was better, but at the end of some time the bars were so misshapen by striking off the clinkers, that he was driven to change them and go back to the old bars.—*Proceedings of the Society of Civil Engineers, Paris.*

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### *On Carriage Springs.**

At the same sitting, M. La Salle gave some account of the theory and experiments of M. Blacher, as to springs, such as suspension springs for carriages. M. Blacher assumes an elastic bar of uniform section placed on two points of support, situated at like distance from the ends of the bar. If to each end of the bar are applied two equal vertical forces, M. Blacher demonstrates that the momentum of elasticity is constant for all that portion of the bar comprised between the points of support, and which consequently on bending takes a curve exactly circular; and that the arms of the lever of the forces causing the flexure are equal to the projection of the bar—that is to say, to the distance from the points of support to the ends. It follows, that if we substitute for the points of support, the extremities of a second bar supported itself by a third, and so on in such manner as to place one upon another, a certain number of bars of equal thickness, of equal width, and having lengths decreasing

* From the London Architect for September 1851.

so that the projecting ends shall all be equal among themselves, then these bars will bend under the influence of the first, only touching at the ends, and all taking exactly the same circular curve.

The parts of the bars projecting from the points of support, will equally bend in arcs of a circle, if care be taken to give them the form of solids of equal resistance starting from the points of support.

This reasoning applies equally to blade springs, bound together of equal radii, and which are straightened by a load.

Mr. Blacher lays down—

First, That the flexure is proportional to the load: that is to say, that at each partial and constant addition to the load, there is a corresponding partial and constant flexure throughout the whole extent of the flexure.

Second, That the flexure is in inverse ratio to the number of springs: that is to say, that for a double load there is needed (all other things being alike) a double number of springs.

Third, That the flexure is proportional to the cube of the length developed by the spring.

Fourth, That the flexure is in inverse ratio of the width and of the cube of the springs or plates.

M. La Salle concluded with some observations of his own. He considered that for a steel spring of the first quality, it ought not to be subjected to a tension greater than would cause an extension of substance of $\frac{1}{300}$ in length. At least, this is his opinion, until further experience determines within what limits elasticity can be maintained. He likewise observed, that the new system of springs, called "compensation springs," has been lately tried in France; these springs being composed of a small number of plates which, in proportion as they bend, spread out on a rigid bar. These springs, which at first sight appear lighter than common springs, are under bad conditions of solidity and durability, because the steel is worked to its utmost limits, and most frequently to a lengthening of $\frac{1}{200}$, so soon as the middle begins to spread out under the influence of a load. If they wished they could work steel as much in common springs, and could considerably reduce their weight, which would then come out much lower than compensation springs. In his opinion, the principle of compensation springs was not rational. He found in them a radical vice, inasmuch as their sensibility diminished just as the load they bear increases—that is to say, that they lose their flexibility precisely at the moment when it should be as great as possible.

M. Polonceau, who has made some experiments lately on the two systems, explained that the new springs spreading out on a rectilinear bar, and shortening by all the length applied on this bar, offer a lever-arm shorter and shorter as they go on bending. At first sight, it had seemed to him, as to everybody else, that under a given load these springs ought to act much in the same way as a common spring, shorter by the whole quantity in contact on the rigid bar: experience has, however, proved that compensation springs exhibit extraordinary elasticity. For the present he had no wish to prejudge the question, as he was engaged in ascertaining the working of the new springs; but he would give an account of his experiments to the society when completed.

M. La Salle is of opinion that the characteristic which essentially distinguishes the two systems is flexibility. In common springs the flexibility is proportionate to the load; in compensation springs, on the other hand, the flexibility decreases rapidly just as the lever-arms diminish under the influence of an increase of load, since the flexure is in inverse ratio to the cube of the length. In the experiments made on the Orleans Railway, they endeavored to load, first, each of the springs under experiment with a steady load of 5000 lbs., then with an additional load of 2000 lbs.; which, being taken off all at once at a given time, caused a reaction of the spring, which was shown by more numerous shakings or oscillations in the compensation spring than in the common spring. Hence it was drawn that the first was more elastic; but it must be said that the common spring, being composed of a greater number of plates, has to overcome greater friction, and that, consequently, its oscillations will stop sooner. To his mind the friction of the plates is of advantage when not carried too far, since it exactly prevents the oscillations from being kept up. A spring should not be absolutely elastic. The principal condition is, that it should be flexible; and as to friction, it absorbs beneficially a part of the force developed by the shock.

A member is not of the same mind as to friction, for if M. La Salle is right, the old springs are best of all; and that cannot be. Springs ought to have a great flexibility; they ought to bend much when heavily laden; and friction must certainly lessen its flexibility.

M. La Salle answered, that if friction is useful within certain bounds, it need not be so excessive as in the old springs. To be easy, a spring ought to be flexible, and produce oscillations of given fullness; and it was not, therefore, to be held out that the friction would be considerable enough to destroy the flexibility of the spring. For ease, it is desirable to make the springs as long as possible, because these being capable of being composed of a smaller number of plates, afford less surface for rubbing. He held, too, there are cases wherein too much elasticity is hurtful. For carriers and diligences he had made springs composed of five or six plates of 0·4 inch thickness. These springs were very easy under heavy loads, but they were less so when the carriages were empty; and in both cases caused them great swaying. Since then, he had put, instead of these springs, other springs made up of a greater number of thinner plates, which afforded much the same flexibility and the same weight. These latter, which showed much more friction, were preferred.—*Proc. of Soc. Civ. Eng., Paris.*

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## *Water Pipes.**

Messrs. Neilson of the Hyde-park foundry, are at present under contract to supply about 30 miles of cast iron pipes to the town of Liverpool, for bringing the water from the Pike. They are 3 ft. 10 in. in diameter, the iron of which they are made being 1⅛ inches thick. Each length measures fully 12 feet; and in every one of these there are nearly 4 tons of iron. Upwards of 1200 have already been delivered and shipped for Liverpool. The average number of lengths turned out does

* From the London Architect for August, 1851.

not exceed five per day, which involves a consumption of nearly 20 tons of iron. Every pipe before leaving the foundry is subjected to a severe test by hydraulic pressure. The moulds, which stand about 13 feet high, are sunk into the ground, bringing the top of the cylinder nearly on a level with the surface. The liquid metal weighing, as already stated, about 4 tons, is brought by means of a steam crane from the melting furnace, and poured into the mould.

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*On the Conduction of Electricity through Water.* *By* Mr. F. C. Bakewell.*

This paper gave the results of some experiments on the conduction of electricity by water, made with a view to prove that an electric current may be transmitted for a considerable distance through unprotected wires immersed in water. The experiments were conducted on Saturday, June 28th, in one of the Hampstead ponds. A thin copper wire (No. 20), 320 feet long, was stretched across the pond, and two copper plates, 10 inches square, to which wires were soldered, were immersed to serve as conducting plates for the return current. A Smee's battery of two pair of plates was used; and when the connexion was made with a galvanometer on the opposite bank, a steady deflexion of 30° was maintained, and a strong blue mark was produced by a steel electrode on paper moistened with a solution of prussiate of potass in diluted muriatic acid. In this experiment the conducting plates were placed close to the wire and on opposite sides of it, so that the return current passed diagonally across the exposed wire. The water in this case appeared to act as a conductor and as a non-conductor at the same time, in proportion to the surfaces exposed to its influence. In the next experiment the wire was doubled, and a current of electricity from the same battery was transmitted through the wires, both being immersed in the water. In this case the deflexion of the needle was more powerful, and it continued steady at 45°. From these experiments, which Mr. Bakewell stated were a confirmation of those undertaken by Mr. Bain and Lieut. Wright with a different object in 1841, he inferred that the exposure of a large surface, as the electric telegraph wires from post to post, presented greater opportunity for the dispersion of electricity in moist atmospheres than the points of connexion with the posts.

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## FRANKLIN INSTITUTE.

*Proceedings of the Stated Monthly Meeting, September* 18, 1851.

Francis Grice, Esq., President pro tem., in the chair.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Letters were read from The Royal Geographical Society, London; and J. Erricsson, Esq., New York.

Donations were received from The Royal Institution of Great Britain; The Royal Geographical Society, and the Royal Astronomical Society,

* From the London Architect for August, 1851.

London; Thomas Ewbank, Esq., Commissioner of Patents, Washington City, D. C.; Simeon Borden, Esq., Fall River, Mass.; J. Erricsson, Esq., New York, and Robert Smith, Esq., George W. Smith, Esq., and Prof. John F. Frazer, Philadelphia.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer's statement of the receipts and payments for the month of August was read.

The Board of Managers and the Standing Committees reported their minutes.

New candidates for membership in the Institute (7) were proposed, and the candidates (6) proposed at the last meeting were duly elected.

Dr. Rand, Chairman of the Committee on Meetings, presented several specimens of iron coated with copper, a new article sent to the Institute by Mr. Ebenezer G. Pomeroy, of Cincinnati, Ohio, and for which he has taken out a patent. His process is as follows:—

Immerse the iron in dilute sulphuric acid, for the purpose of cleansing the surface of the article which is to be coated; and thus cleansed, submit the iron to a brisk heat to dry it; when dry, immerse the article in a mixture of clay and water, and again dry it so as to leave a thin coating of the clay on its surface; it is then to be immersed in a bath of melted copper, and the length of time requisite for the iron and copper to form a union, will depend on the thickness of the article under operation. The object of the clay is to protect the copper from oxidation during the process of alloying or coating, and to reduce it to the required thickness it is passed between rollers. The result of this annealing process will be a smooth surface, fully equal to the brightness of pure copper.

The specimens presented to the Institute had all the appearance of pure sheet copper, and are considered by the patentee applicable to the same purposes.

Dr. Rand also exhibited specimens of cotton fibre which had been immersed in a cold solution of caustic soda, after the method of Mr. Mercer, by which the fibre had undergone condensation. The amount of this change was stated to be one-fifth to one-third of the original volume of cotton employed, increasing its fineness by a chemical union with the soda. By this process the strength of the fibre was also stated to be increased in the proportion of 20 to 13; and certain colors are much brightened. (Vide Report of the British Association in *London Atheneum, for July,—Journal of the Franklin Institute, present Vol. p.* 204.) This subject will again be brought before the Institute.

Mr. G. W. Smith brought before the meeting an interesting specimen of flax cotton, made after the process of C. Claussin, and gave an account of his method.

The next subject of interest was an exhibition of the operation of one of Phillips' Patent Fire Annihilators, which was kindly loaned for the occasion by Mr. Sandford, of Adams' Express of this city, and put in operation by Dr. Hall, one of the patentees in this country. The portable apparatus is sixteen inches in height by eight inches in diameter, and consists of a machine composed of two thin iron cylindrical cases within one another, the central case containing a brick composed of charcoal, sulphate of lime, and nitrate of potassa, and in the centre of this brick a

bottle containing a mixture of chlorate of potassa, in which is contained a portion of sulphuric acid. This deflagrating compound fires the inside by a pin being pressed down from the top so as to break the vial and ignite the brick, which creates a great amount of heat, sufficient to generate steam in the bottom of one of these cylinders, which unites with the gases evolved so as to produce a large jet of white vapor, without any suffocating odor; it was exhibited in a room in which there were not less than fifty persons, without producing cough or any disagreeable impression. The apparatus was merely exhibited in order to show its construction and mode of operation. A trial to test its practical merits was announced to take place in a few days.

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COMMITTEE ON SCIENCE AND THE ARTS.

*Report on Wm. C. Grimes' Steam and Water Indicator.*

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts, to whom was referred for examination, a "Steam and Water Indicator," invented by Wm. C. Grimes, of Philadelphia, Penna.—REPORT:—

That the instrument of Mr. Grimes, which is intended to indicate continually the height of the water, and pressure of the steam in a boiler, at any required place at whatever distance from the boiler, consists in two metallic tubes which are inserted, the one into the steam space, the other into the lower part of the water space of the boiler, and extend from the boiler to the place at which the indications are required to be made, where the ends of the tubes are brought side by side and connected together by a bent glass tube, one end of which enters each of the metallic tubes. In the simplest form, (which is described for the purpose of explaining most simply the theory of the apparatus,) the tube connected with the steam space (which may be called the upper tube) enters the boiler at the water line and runs for some distance horizontally, or a little inclined downwards, when it again bends downwards for some inches, and then runs in any convenient direction to the glass tube. The object of this arrangement is to allow the steam to condense in this part of the tube, and to keep the water which fills it always at the proper water level of the boiler. Each of the tubes is provided with a stop-cock near the boiler, and on each of them immediately below the glass tube there is a small hole, (called by Mr. Grimes the air-hole,) which may be closed by a screw. In order to put the apparatus in working order, the boiler is filled to above the water line, the stop-cocks of the tubes being closed, and a small pressure of steam raised; the stop-cock of the upper tube being then opened a little, the water will enter the tube, and expelling the air before it through the air-hole, will finally begin to run through this hole; the stop-cock of the upper tube is then closed and the plug of the air-hole screwed in. The lower tube is then filled with water in a similar manner. The apparatus then contains water in the metallic tubes, and air in the glass tube or gauge. If now the stop-cocks on the tubes be opened, and the pressure of the steam increased, the air in the gauge will be compressed proportionably, and the water will rise to an equal height in each branch of the tube; in this way the gauge may be graduated by direct experiment. But the fall of the water level

in the boiler will cause the level to fall also in that branch of the gauge which communicates with the lower tube, (that is, the tube opening near the bottom of the water space of the boiler,) and this will cause the water to rise in the opposite branch of the gauge in consequence of the necessity of the column of air retaining its bulk. While, therefore, the pressure of steam in the boiler is indicated by the mean height of the columns in the gauge, the fall of the water below its adjusted level will be indicated by the difference of the height of these two columns, provided the level of the water in the boiler end of the upper tube be maintained constant.

In practice this construction is modified by the introduction of another vertical tube connecting the end of the upper and lower tubes near the boiler. The upper tube is then inserted into the steam space of the boiler, and it leaves the connecting tube at the proper water level, when it runs as before described; in this way there will be left but a small portion of the upper tube to be filled by the condensed steam. The lower tube is also provided with a blow-off cock between the boiler and the stop-cock before described, to prevent this tube from being choked by sediment. The level of the water in the gauge is indicated by a floating glass tube, colored and graduated in the inside, and closed in the leg communicating with the upper tube, while a glass ball floats on the surface in the other leg. The difference in the levels of the water columns is then indicated by the position of this ball on the graduated scale of the glass tube in the other leg.

The indicator thus described has been for some time in operation in several steam boilers in our city—especially in the boiler at the office of the Public Ledger, where the gauge is brought up into the office, and may be seen constantly in action. And so far as the committee can learn, they appear to have given satisfaction.

The committee regard the invention of Mr. Grimes as a very ingenious one, and as fulfilling a very desirable purpose, that of indicating the steam pressure and water level of a boiler, in the office of the manager of the establishment. They think that it will require an experience of some time to ascertain satisfactorily that the water level of the boiler and of the tube connected with the steam space can be kept constant by the condensation of the steam, but they see no other practical objection to the instrument, which appears so far to have given satisfaction in practice. And as they believe that it will be found to be useful in engineering, and so far as they know, new, they recommend that Mr. Grimes receive the Scott's Legacy Medal for his invention.

By order of the Committee.

WILLIAM HAMILTON, *Actuary.*

*Philadelphia, July* 12, 1851.

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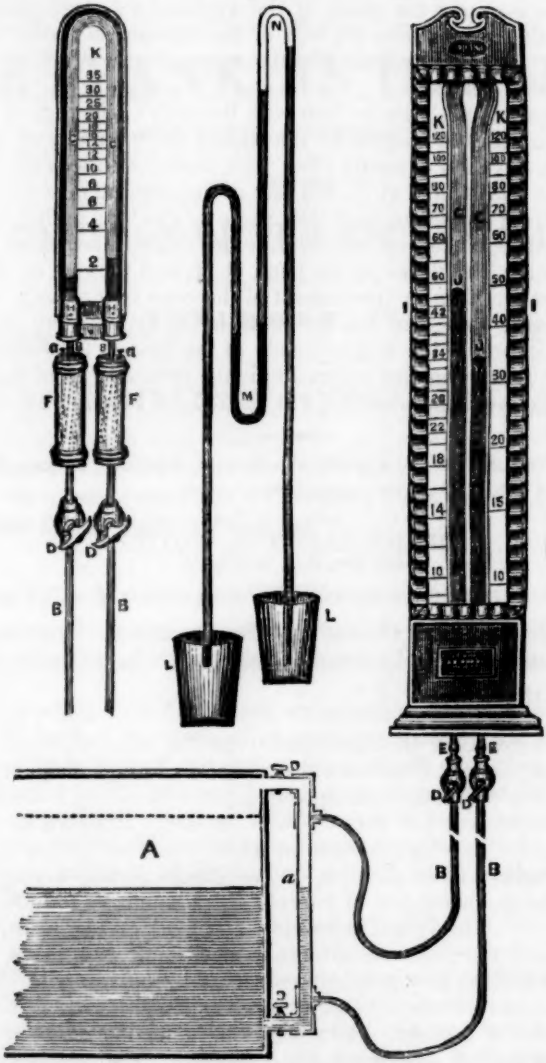
*Description by the Inventor, of the Gauge for showing the Height of Water, &c., referred to in the foregoing report.*

The figures represent two forms of the instrument, together with an illustration of the principle upon which they act.

The same letters refer to like parts.

A, is the boiler; *a*, reservoir of water; B B, metallic tubes; C C, legs to the glass syphon; D D, the stop-cocks; E E, are screws closing

Fig. 1. Fig. 3. Fig. 2.




apertures in the tubes, which are to allow the air to escape as the tubes fill with water or other fluid. F F, in fig. 1, are reservoirs for containing quicksilver, or other dense fluid. The tubes B B, both from above and below, extending into the reservoirs nearly to the opposite end of